November 18, 1920

Engineering News-Record

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The Georgetown Bridge Across the Potomac
One of the Largest Concrete Bridges Now Under Construction

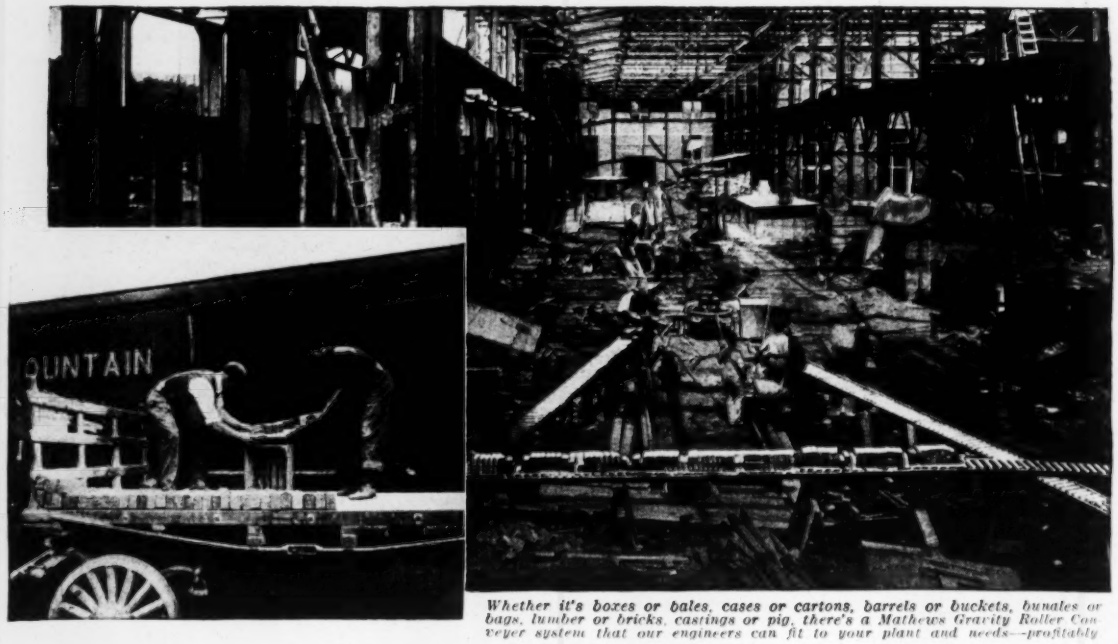
Pipe Line Velocities for Transporting Gravel
By P. J. McAuliffe

Effect of Fire on Concrete Warehouse at Galveston

Freight Yard Improvements for C. B. & Q. R. R.

Ten Years' Operation of Columbus Garbage Plant

Constructing Georgetown Bridge Across Potomac River



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 85 — NEW YORK, THURSDAY, NOVEMBER 18, 1920 — Number 21

Better Freight Yards

IN THE broad scheme of railway improvement which must be undertaken to obtain increased speed economy and efficiency in transportation, one of the principal items will be freight yards with better facilities for quick switching movements. In some cases new yards will be established, in the design of which the engineer will have a free hand. Far more general will be the improvement and enlargement of present yards, where conditions of traffic and area are limiting factors in layout revision—as at Lincoln, Neb. (See p. 996.) As a typical case this revision is worth careful study.

Bond Election Results

LATER returns of votes cast Nov. 2 on state and municipal bond issues justify our comments of last week to the effect that the mass of the people, through their willingness to vote money for public improvements, have renewed confidence in our industrial future. True, it now appears that in several states constitutional amendments authorizing road bond issues failed, as did the proposed state railway tunnel bond amendment in Colorado, but a large total of state bonds—principally for roads—carried. A full knowledge of conditions affecting some of the defeated state bond proposals would probably show that if any error of judgment had been made it was due to mixed issues or to a conservatism deserving at least as much praise as blame. Discrimination in voting on bond issues is commendable.

End of Car Shortage in Sight

WHEN car reports for the current week are published the country may find that the end of car shortage has virtually been reached by a return to normal conditions. For the week ended Oct. 30 the excess of car requisitions over the supply was 55,412, compared to 65,965 for the preceding week. Of the reported shortage approximately 17,500 cars are represented by loads held awaiting export shipment. The worst average condition following the switchmen's strike was represented by a shortage of approximately 145,000 cars. Since that time movement and loading have steadily risen and more recently have been accelerated by the 30-miles-per-day-30-tons-per-car program of the Association of Railway Executives, until car loading passed the million mark during the first three weeks in October. The record is one of unprecedented accomplishment, with great credit due the railroad managements. For the last week in October a decrease of 26,000 in cars loaded was noted, indicating an actual falling off in traffic, further borne out by subsequent estimates. Evidently the backbone of the car shortage situation has been broken, but, according to Interstate Commerce Commissioner Aitchison "what has been done was first aid and not a cure."

To Facilitate Interstate Engineering

ENGINEERS will heartily welcome the National Council of State Boards of Engineering Examiners which unostentatiously came into being Oct. 7 in Chicago (see news pages). Interstate business of consulting engineers has already been subjected to annoyance if not actual curtailment because of the lack of workable reciprocity clauses and uniformity of requirements for license or registration, and such troubles will increase as registration spreads. The new organization proposes to iron out these difficulties and make the engineering service throughout the United States as fluid as the interpretation of the various laws will permit. Seven states are now represented in the council and it is hoped that the other four states which have license or registration laws will follow suit. Until a uniform law can be secured in all the states—a long hard task, if ever achieved—uniformity in administration should be the aim. The provision for uniform examination already made in Illinois and Michigan should be extended to other states.

"Low-Grade" Tonnage Rates

DURING the period that the recent flat percentage increase in railroad freight rates has been in effect, complaint, and we believe just complaint, has been made by shippers of some "low-grade" materials which are very largely subject to the short haul since they originate in many sections of the country and cannot compete in long-haul trade. The construction industry has felt the effect of such rates acutely because so many of its materials fall in this class. While the general advance in rates since 1913 has been about 101 per cent, the percentage increase on some low-grade, short hauls has been much more. This resulted from the Director General's order No. 28, during Federal control, by which short-haul rates were increased in amounts ranging up to 50 per cent, though the general increase was only 25 per cent. The effects of this order have been accentuated by the recent blanket percentage increase. Now, for instance, the increase on the minimum short-haul rate on sand and gravel is 142 per cent greater than the 1913 rate, while the general increase is only 101 per cent. Since the terminal cost of handling low-grade tonnage is usually very much less than the handling costs of most other commodities—particularly where cars must be made up and broken at more than one point—there is good ground for complaint respecting existing rates on certain low-grade short hauls. The Interstate Commerce Commission had to take such quick action in the recent increase that it was impossible to go over the whole rate structure. However, some low-grade tonnage, such as iron ore, did receive consideration. Now the case of other low-grade commodities should be taken in hand. Equitable adjustment is possible, without impairing railroad income, by placing the burden where it can better be borne.

Why Let India Surpass Us?

INDIA is a land of cheap labor and it is not an industrial country, yet one of its government reports asserts that "the whole industrial future of India is bound up with and dependent upon the provision of cheap power." On the basis of this need further detailed attention to India's water power is urged—in the report reviewed elsewhere in this issue—and, judging from previous policy, that attention will be forthcoming, backed up with the necessary government funds. A significant sidelight on water-power development in the United States is that British engineers in reporting on power sites in far-away India cite the fact that the United States has utilized only 24 per cent of its available water resources and compare this with the 43 per cent developed in Germany. In a country as young, comparatively, as the United States it is not to be expected that we would have a high percentage of development but by this time we certainly should have very definite and exhaustive information about water-power resources. It is a pity that so great an industrial country as the United States, where labor costs have been on the increase for years, where modern civilization demands almost universal use of power, particularly electric power, and where water-power sites are many and easily accessible, should be so far behind in water-power investigation.

Friction Heads in Hydraulic Dredging

QUANTITATIVE knowledge of friction heads is of great importance in hydraulic dredging operations. Recognizing this fact, what engineer can put his hand on a published record which contains accurate and comprehensive values of friction heads where mixtures of earth and water are being pumped? In some way it has come to be assumed that at ordinary dredging velocities of 12 to 15 ft. a second the friction head in pumping earth and water is about 4 ft. in 100 ft. Obviously this cannot be true of all mixtures regardless of the character of the earth, stream velocity, percentage of solids carried and pipe size and alignment. Yet almost no test information is available as basis for more precise assumptions. Under these conditions the tests of P. J. McAuliffe, described on p. 988, form a notable contribution to our stock of data, even though the tests were somewhat crude. As such data accumulate hydraulic dredging practice is likely to see much development in its detail practices. For example, the observations made during the hydraulic-fill operations of the Miami Conservancy District (described in our issues of Sept. 9, 16 and 23, 1920) were such as to show that it will pay to take great care in the layout of pipe systems. In that work a friction head of 4 ft., found in pumping fine glacial till and clay, was about the minimum; ordinary drift of clay, sand and gravel required a head of 6 to 8 ft., while with heavy, harsh glacial sand and gravel the heads rose to 10 and 12 ft. Friction losses as high as this place a heavy penalty on pipe-line lengths and on bends and irregularities. In similar manner any other quantitative study of pumping is likely to lead to more efficient planning of work. Mr. McAuliffe's contribution tends toward progress of this kind. In addition it contains some interesting suggestions, among them that friction may decrease when the flow velocity is increased—a phenomenon of interesting possibilities.

The Refusal to Enter the Federation

LAST week's decision of the American Society of Civil Engineers to refrain from joining the federation creates a situation which may easily lead to unfortunate antagonisms. On the one hand, the societies in the federation may be sharply critical of the civil engineers. The civils, on the other hand, may be inclined to stand off and be indifferent to the federation's success or failure. Such attitudes would intensify the rift and prevent intercourse that would eventually remove the obstacles and permit engineers to present a unified front.

There is, we believe, unanimous demand for some sort of federation, or association, or committee to tie the engineering influences of the country together. Some believe it should be a strong organization, others that a loosely formed committee will suffice, still others that only a clearing house is needed. But while opinion may differ on the form of association we have yet to meet the engineer who believed that no centralizing organization was needed.

That some type of organization is demanded, therefore, is the premise of the argument. If the new federation should fail it would be a serious blow to the possibility of engineers getting together; the present members would be discouraged and would be unwilling to unite on any further venture. Whatever the civil engineers may think as to the defects of the federation, no matter how greatly they believe it must be changed before they can participate in its activities, they should, nevertheless, regard it as the nucleus of the organization through which all engineers will eventually function together. The changes may divest it of all resemblance to its present self, but it must be the nucleus unless there is to be discouragement that will long prevent the forming of an effective organization.

On the other hand, the federation needs to take serious thought of the objections of the civil engineers to the end that those objections in so far as they may be found valid may gradually be removed. Compromise now would seem impossible. The federation must begin to function and through its functioning discover its deficiencies and its strength. Then only can the correctness or fallacy of the civil engineers' contentions be determined.

The American Association of Engineers, if we have correctly sensed its attitude, is an illustration of what a benevolent neutrality might be. The association will not join the federation. On the other hand, it will not attempt to set up antagonisms. It has signified its willingness to co-operate with the federation where the interests are mutual. Such a relationship will be favorable to the modification in time of one or both the organizations—to consolidation possibly—to whatever may be to the best interests of the profession.

Finally it will be well for all parties to remember that the vote of the civils on the federation may have been much influenced by the society's internal situation. The amendments, the federation itself, the proposal to enter the federation and the coming election of officers are all intermeshed. We are not prepared to say that the result would have been otherwise had the federation proposal stood alone, but we are sure that the recent balloting was accompanied by prejudices awakened by other issues. Later it will be possible to weigh in calmer mood the proposal to work with other societies.

That there may be calmness, that there may be, some years from now, a mending of the present rift, it is important that the attitudes of the federation and of the American Society of Civil Engineers toward each other be one of sympathy and one that will in all things make for mutual understanding.

Successful Prophecy, and the Future of Rail Quality

SOME years ago railway rails were failing at an uncomfortably rapid rate. Traffic had been growing heavier, and rails had not been getting better in due proportion. Perhaps the conscience of public and railway engineers had become more sensitive, too—at all events the rail problem was made a matter of anxious study. Not long after this study began, M. H. Wickhorst, one of the engineers engaged in it, predicted that progressive improvement in the matter of rail failures might be expected, and he sketched a curve showing how rail failures would decrease during the next half dozen years; in effect he predicted that by 1921 or 1922 nine-tenths of the rail failures would be eliminated, as compared with ten years before. Mr. Wickhorst has qualified as prophet, for the 1919 record of rail failures, just published, shows an amazingly accurate agreement of the actual failures with the curve he forecast; 80 per cent reduction in failures has already been attained. The physical phenomena of rail service and failure are exceptionally intricate and erratic, and no law governs the improvement that has been recorded, yet the prediction and the verification are such as would be eminently satisfying even in the case of a sequence of events following definite laws.

Fully as surprising as the outcome of the prediction is the fact that no one knows how the improvement in the rail situation was brought about; or, at least, no one has yet told. It did not result from more precise specifying of quality, for rail specifications have not changed essentially. Nor is more careful inspection a probable factor. It seems necessary to conclude that the improvement was brought about in part, if not wholly, by persistent effort of the steel-mill men themselves—due perhaps to the spur of publicity, since the yearly publication of the scores made by the different mills tended toward competition for the best showing. The competition could only supply a motive, however, and it remains a secret what means the mill men employed to improve their rails.

More care in the melting and rolling of rail steel was a factor—that much may be taken for granted. For during the war years, when manufacture was inevitably hurried and less careful, and when attention was concentrated on products other than rails, the scores became poorer. Still, it should be possible to express this intangible "carefulness" in terms of measurable quantities; we cannot safeguard ourselves against a return to the more dangerous rails of ten years ago merely by pleading with the producers to be careful! We must translate our request into terms of procedure to be followed, properties desired, or tests to be met. This may become possible when the steel men reveal the secret of their campaign for rail improvement, a story that will doubtless be interesting in more ways than one.

Meanwhile, however, a mystery remains, one on which the whole future of rail safety may depend. The mystery lies in the fact, clearly proved by the statistics, that most rails are safe, while nearly all the early failures are localized in a small minority of the mills' rollings. Out of, say, a dozen lots of rail produced by a given mill in one year, each lot comprising thousands of tons, most of the failures developing during a given period of service are assignable to two or three lots, while the others come through the same number of service years with almost no failures. This fact points to a critical difference between separate lots of rails. Most of them are not merely good but extremely good, while a few are extremely bad. If it were possible to discover why these occasional lots are bad, a sudden gain in rail safety would be within reach.

Now, there is no reason to believe that all of the rails in one of these lots contribute to the failure epidemic which marks that lot as abnormal. Indeed, there is no reason to believe—except because the statistics happen to be assembled that way—that *the lot as such* is abnormal at all. Probably a few small component parts of the lot, a few furnace-heats, are abnormal. There is no variation of procedure as between lots, nothing that would cause one entire lot to be bad and another good. If the small chance changes in the items of mill operation were responsible for the occurrence or non-occurrence of rail failures, then the failures would be distributed over all rollings according to the laws of chance, either uniformly or according to the probability curve.

In fact, when the rail record of any one mill is studied the failures are seen to be distributed in so abrupt and spotty a way among the consecutive rollings that they cannot be due to any element of procedure which remains constant or nearly constant throughout the course of a rolling. Whatever the cause that produces bad rails, it can occur only rarely in the course of the rolling of a 1,000-ton lot—the minimum reported in the official statistics—but evidently is of strong effect when it occurs. This meteoric incidence seems to center the responsibility on the heat as a unit: one or a few individual heats in the course of a rolling are defective.

To restate this conclusion: the abnormal number of failures which the records charge against a given rolling should, instead, be charged against a few furnace heats out of the many comprised in that rolling. While this could be proved or disproved readily were rail failures reported and grouped by heat number, we must for the present be content to accept it as a conclusion having a high degree of probability in its favor. And, as it has the merit of indicating the most promising point of attack on the rail problem, it may claim to be the best working theory available. This point of attack is furnace and ingot-casting practice. So soon as that practice is made uniform heat epidemics of rail failures can no longer occur.

Hitherto studies directed toward the improvement of rails have ranged over the entire field from steel furnace to railway track. Blame has been placed by one investigator on high carbon, by another on premature or too rapid rolling, by others on one-sided cooling, on kinking in the straightening press, on excessive wheel loads from locomotives, on cold weather and frozen ballast, and so on without end. But if the present discussion of the case is sound, most of these indictments may be dismissed, since the ingot itself contains the seed of future rail destruction, regardless of rolling mills, wheel loads and weather. It is in study of the ingot, then, that the best promise lies for early progress in the improvement of rail quality.

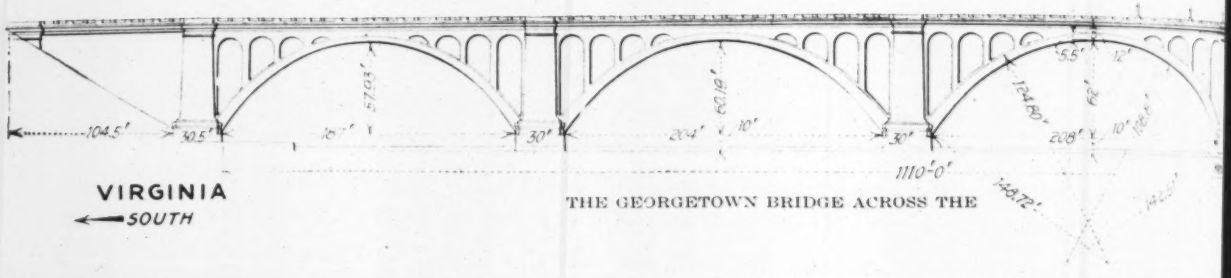
Army Engineers Build New Highway Bridge Across Potomac

Concrete Structure at Washington, D. C., Replaces Old Aqueduct Bridge—Ribs Poured on Steel Arch Centers Floated Into Place on Scows

ONE of the largest concrete bridges now under construction in the country is being built by force account by the Corps of Engineers, U. S. Army, across the Potomac River at Washington, D. C., to take the place of the old Aqueduct Bridge which has been in existence for more than eighty years. Congress has officially named this structure the Georgetown Bridge. It was known originally as the Key Bridge, its Georgetown approach being near the home of Francis Scott Key, the author of the "Star Spangled Banner." While it has no outstanding features of structural novelty, the methods of construction are interesting, particularly the use of centers made up of steel arches which are built on scows and floated into place.

The old Aqueduct Bridge crosses the Potomac River between Georgetown, D. C., and Rosslyn, Va. It was built from 1832 to 1840 under the direction of Major Turnbull, of the United States Army, for a combined roadway and an aqueduct carrying the Chesapeake & Ohio Canal across the river. The United States purchased the structure in 1886, and in 1888 the timber aqueduct was removed and an iron deck truss erected in its place. There has been for a long time trouble with the pier foundations which have required constant attention and maintenance, and the bridge structure itself is quite inadequate to carry the heavy traffic which now passes between Washington and its Virginia suburbs.

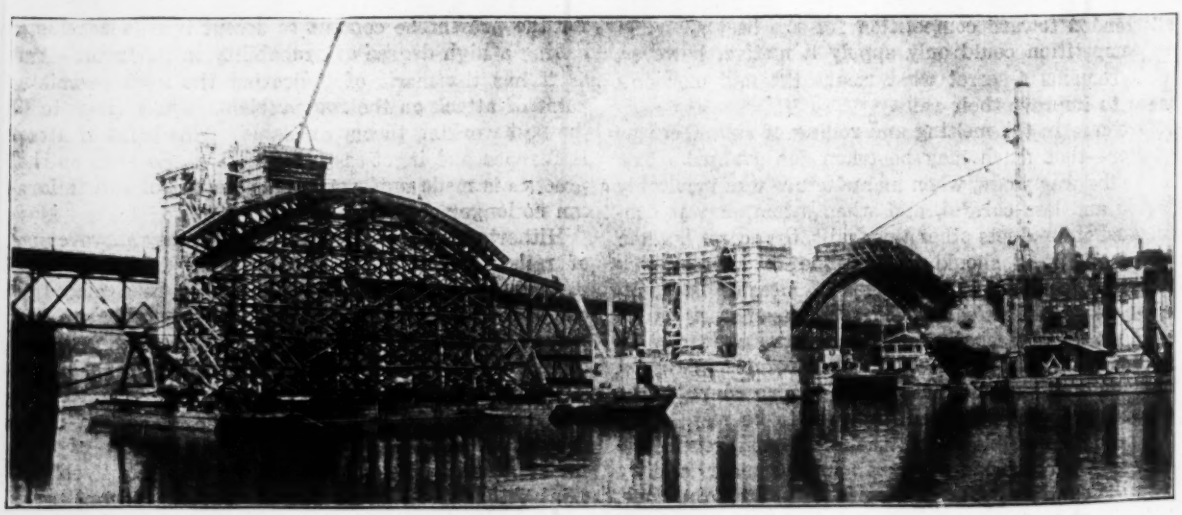
By act of Congress, May 18, 1916, the construction of a new bridge to replace the Aqueduct Bridge was authorized, $150,000 was appropriated for surveys, plans, estimates and for the purchase of necessary land for approaches, and $1,000,000 was authorized for construction purposed. Since that time the sum of $2,100,000 has been fixed by Congress as the authorized cost of construction. As the bridge crosses a navigable river between the District of Columbia and a State it comes under the jurisdiction of the United States and the construction was assigned to the Corps of Engineers.



THE GEORGETOWN BRIDGE ACROSS THE

Surveys made soon after the initial appropriation led to the location of the bridge, as shown in one of the drawings, at a point east of the present structure and on such an angle thereto that the Washington approach is one city block east of the old Washington approach, while the Virginia approach intersects that of the old bridge 100 ft. south of the south abutment.

Reinforced concrete was selected as the material for the structure. The total length, including approaches, is about 2,700 ft., and the length of the masonry structure proper, about 1,450 ft., which length is made up of a central 208-ft., arch over the center of the

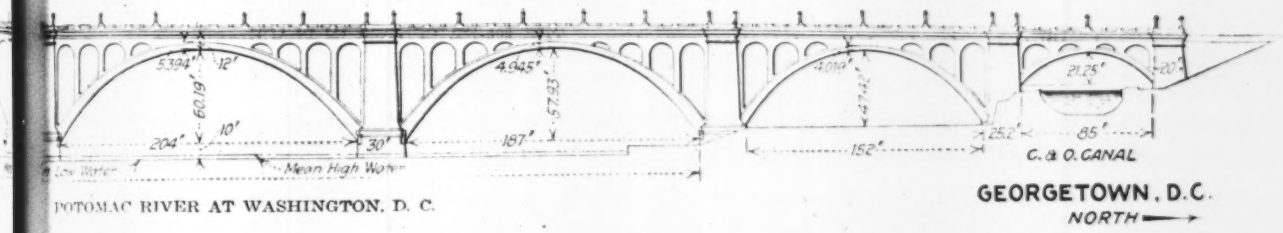


CONSTRUCTION OF GEORGETOWN BRIDGE IN LATE OCTOBER
Looking toward Washington on North Shore

channel with arches on either side 204 ft. and 187 ft., and approach arches of 152 ft. and 85 ft., the latter being over the Chesapeake & Ohio canal, on the Washington side.

The depth of water in the river is about 22 ft. and fairly uniform over the entire area. The rock surface varies in depth from 24 to 26 ft. below mean low water, and the normal range of tide is about 3 ft. High freshets are of infrequent occurrence and short duration, but they do attain a considerable height at times. During the freshet of June, 1889, for instance, the water reached 19.5 ft. above low water, this being the maximum of which there is any record. Extensive rock excavation, including core borings at each pier and abutment, shows a solid Potomac gneiss formation which carried no open seams.

The bridge is 70 ft. wide from out to out of cornices, which allows for a double-track electric line, two 16-ft. roadways, and two 8-ft. sidewalks. Street cars are



POTOMAC RIVER AT WASHINGTON, D. C.

to use the central conduit system common in the City of Washington, which fact requires a somewhat unusual floor system arrangement, as shown in the drawing and described hereinafter. The height of the bridge above the river at midstream will be about 85 ft., and the elevation of the bridge at shore abutments 79 ft., allowing a clear waterway at the center span of 72 ft., at the second spans of 70 ft., and at the short spans of 68 ft. There is little navigation at this part of the Potomac River, except for pleasure craft, as tidewater stops at Little Falls, about two miles upstream.

The structural design of the several arches is consistently the same, except for the variations due to dimensional differences. The river piers are of solid concrete up to the top of the springing line of the arches, above which point the piers separate into three shafts corresponding in width to the three arch ribs. The abutments are of similar design, except that they are founded on solid rock above water and they are further extended by counterfort reinforced-concrete retaining walls to retain the fill.

The details of these retaining walls are shown in one of the drawings. They consist of thin walls, attaining a maximum height of about 55 ft. and of a thickness varying from 20 in. at the top to 30 in. at the bottom, reinforced as shown against bending and resting on reinforced-concrete precast pile footings. The walls are held in position against the outward thrust of the retained fill by continuous counterforts running clear across the abutments. These counterforts are concrete walls reinforced in both directions as shown. The roadway as well as the approach is carried on an earth fill inside the box.

As stated, the arches are of the three-ribbed type, the inner rib being 21 ft. wide and the two outside ribs each 11 ft. with a 3-in. showing corbel, the clear space between the ribs being 11 ft. 6 in. Each rib is a solid reinforced-concrete arch, the reinforcement, however, not being exceptionally heavy, as shown in the details of the 208-ft. arch given herewith. The ribs are braced across at intervals of about 20 ft., with transverse beams 18 in. wide and nearly the depth of the arch ribs. The roadway is supported on spandrel posts 48 in. in the line of the bridge and 36 in. transverse to the bridge. Two of these posts are on each side rib and three on the center ribs, the posts being connected by a cross-wall 12 in. thick. They support the roadway, which is of combination I-beam and reinforced-concrete construction as shown in the detail.

The main feature of this floor is the small posts placed on the spandrel walls which are connected by I-beams incased in concrete. Above this is the structure proper, which is built in to accommodate the yokes of the underground trolley street car system. This particular form of construction was made in the original design in order to utilize some I-beams which were used in the cofferdams in building the piers. There is now under contemplation, however, a change of the design whereby an ordinary jack arch system of floor supports is used. Expansion joints in each arch are provided at one end of each of the spandrel arches, as shown in the drawing, and a double floor post support is provided at each joint.

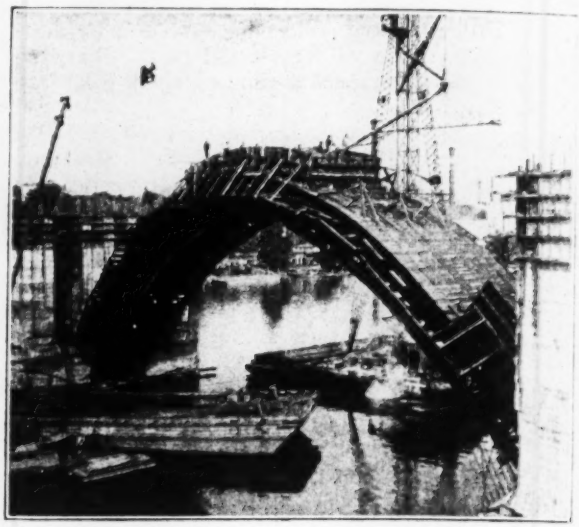
The river piers were all built within cofferdams which were pumped dry before any of the excavation inside of them was made or any of the concrete placed. These dams were in about 22 ft. of water with a covering of 3 to 4 ft. of mud over the rock bottom. No difficulty was found in laying them dry or in keeping them dry. The uniform practice in the construction of the cofferdams was to frame the bracing of the dam, which was about 40 x 100 ft., in plan, complete on the shore and float this framework to its proper location, where it was sunk into place by loading. The sheathing for the dam was then driven. This sheathing consisted of sections made up of a composite of 12-in. I-beams with 5 x 5-in. timbers bolted to 7-in. channels with their legs turned inward, as shown in the detail drawing. It was found quite easy to drive this type of sheathing in place in the small bite in the mud which it had to take. The I-beams were subsequently used in part of the falsework to the bridge, and will be used in the floor superstructure. They are readily pulled and are now on the job straight and quite reusable.

In concreting the cofferdams for the base of piers the earlier piers had form boxes placed around the lower bracing and concrete was poured in pockets made by these boxes up to a point well above the lowest wale and its cross-bracing. In the last pier which was placed, however, the concrete was poured uniformly up to the base of the lowest wale and its cross-braces, when that whole system of bracing was removed and the

concrete already placed used as a backing for the braces of the lowest wales of the dam. The succeeding concrete was poured in stages from wale level to wale level, each line of braces being removed as the concrete reached it. It was found that the work could be done more rapidly this way than by the earlier method.

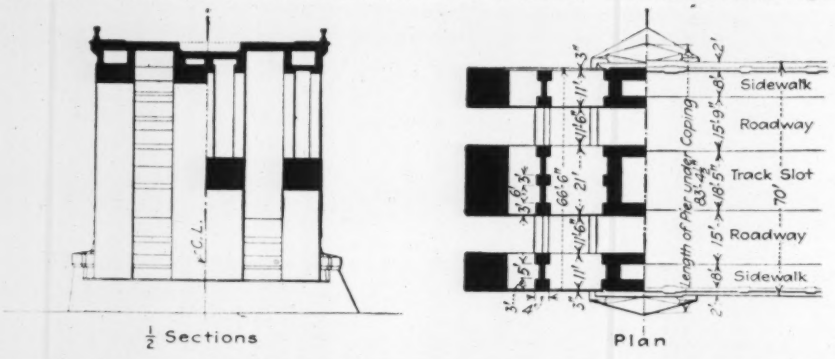
The abutments were placed in the dry, excavation being made behind timber sheetpiling. Pier 5, which is just south of the Chesapeake & Ohio canal, is in the south wall of that canal. This is an old rubble wall with earth fill and not at all stable. It was necessary, therefore, to place this pier in two halves, the southerly half being completed and used as a support for shoring before excavation was carried through the northerly half to the canal edge. The canal was retained during this latter excavation and during the placing of the concrete in the pier behind a straight sheetpile wall made up of the I-beam and channel combination sheathing.

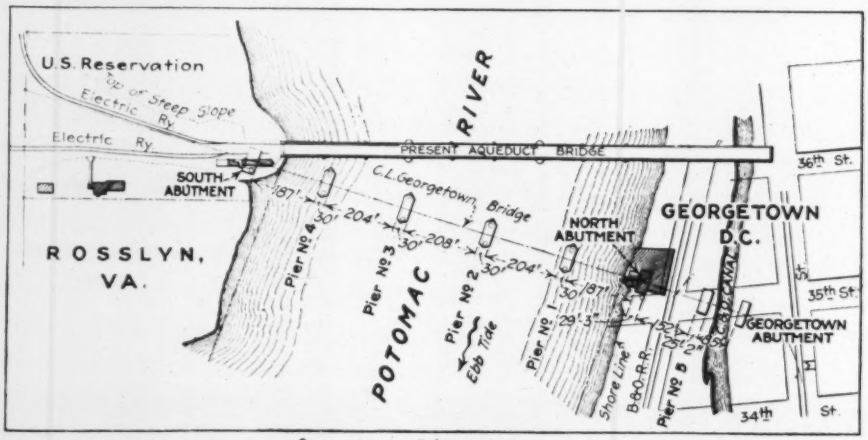
Special consideration was given to the matter of centering for the arches. While floods in the Potomac River are occasional, still the spring ice danger is quite marked. Jams have been known to occur which piled up the ice near the old Aqueduct Bridge and sudden thaws cause floods and ice battering which would be extremely dangerous to any supported centering. Steel arch ribs spanning the piers were therefore decided upon, but it was some time before a final decision was given as to the proper method of erecting these ribs. Finally it was decided that it would be more economical to erect the ribs on a timber trestle mounted on scows and float the scow into place between the piers with the tide. While this required a considerable amount of timber falsework for the erection, it was felt that it would save money over that required to have large derricks erected on each pier which would have to be used to swing a half arch into place were those arches built by the method sometimes in use for steel arch centres. Another alternative of having the arches swung into place from a heavy floating derrick was abandoned because of the impossibility of getting such a derrick or high cost of building one.



THE 208-FT. CENTER IN PLACE

Full centers for the arches are used only for the 208-ft. and 204-ft. spans. In the 187-ft. span the lowest panel of the rib is removed and for the 152-ft. span the lower two panels are removed. The method used is shown in the accompanying views and drawings. Eight steel arch rib centers, built by the Blaw-Knox Co., are supplied for the work. These are put together in groups of two, each group forming a support extending over the entire rib width. Two sets of two trusses each form the centers for a single arch and are to be used successively, first the group of two being used under the center 21-ft. rib and after that has been cast the set on either side is to be moved sideways to form the outside 11-ft. rib. One complete set is to be used under the 208-ft. and the two 204-ft. arches, and another complete set under the two 187-ft. and the one 162-ft. arches. The 85-ft. arch will probably be concreted over fixed centers although the design of the centering permits it being adapted even for this small arch. The general details of the steel





Georgetown Bridge Plan

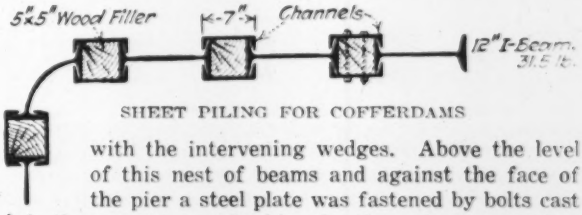
BOX ABUTMENT AT SOUTH END OF GEORGETOWN

centers are shown in the accompanying drawings of the complete set for the 208-ft. arch. The design is peculiar only in the adaptation of the standard to the varying span lengths. Thus the full size rib is used for the 208- and 204-ft. spans, taking care of the variation by dropping the lower pin elevation. For the 152-ft. span the lower two panels of the rib are removed and the lower pin placed in the upper chord of the rib as shown in one of the details For the 85-ft. span only the upper two panels of the rib would be used.

The center unit, as shown, consists of two three-hinged arch ribs spaced 7 ft. c. to c., with upper and lower chords of built-up sections in straight line chords. Spanning these chords are I-beam stringers bolted to the ribs and these beams carry the 3-in. lagging through blocking which varies with the curve and span of the arch. At the crown of the 208-ft. arch, for instance, this blocking is about 4 ft. high, as shown in one of the views.

The forms of the concrete ribs are of wood braced back to the outstanding I-beams on top of the centers. They are in unit sections of a standard length to fit the concreting sections as indicated on the main arch elevation herewith They are also in two transverse sections, which being joined together make the full 21 ft. which for the middle rib but which can be separated for the 11-ft. side ribs. It is the intention, therefore, to use these rib forms over and over again.

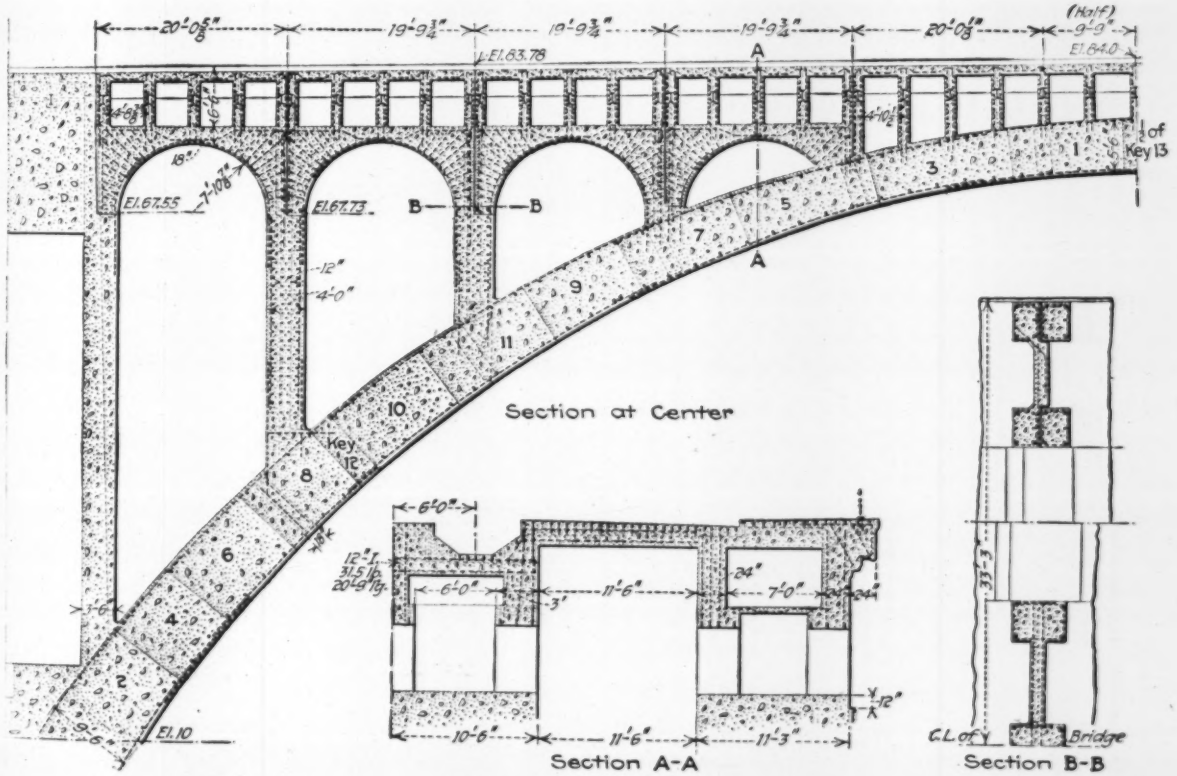
The lower hinge details are shown on one of the drawings. A projecting corbel was left in the lower part of each pier, and a cribbing of timber built up on it for the width of the pier. On this was mounted, in proper transverse position, the nest of I-beam cribs



SHEET PILING FOR COFFERDAMS

with the intervening wedges. Above the level of this nest of beams and against the face of the pier a steel plate was fastened by bolts cast into the concrete as a backing for the arch centers when placed. The shoe of the rib was bolted onto the rib itself and when the centers are dropped into place, as described below, the bolts protruding from the pier are sliped into the outstanding angle on the shoe, and the vertical steel wedges dropped into position behind the shoe. In striking the centers the wedges under the shoe are to be knocked out and the centers lowered on hydraulic jacks.

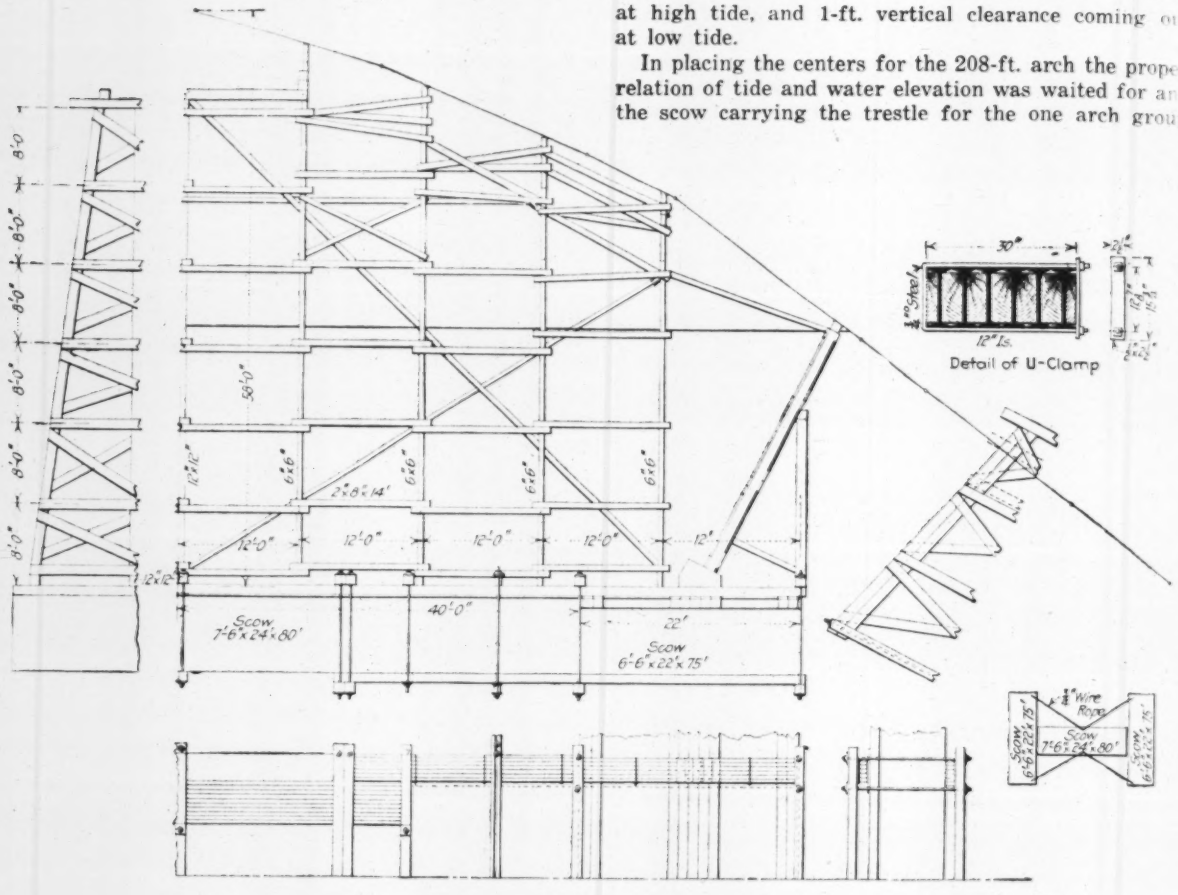
The steel arch ribs are floated into place on a heavy trestle supported on three scows lashed together in the shape of the capital letter I, this lashing being both by means of continuous I-beams over the joints. The detail is shown in one of the drawings. On this group barge is erected a wooden trestle which supports the steel arch ribs mainly at the crown and at a point about the haunch. Intermediate supports are not counted on in holding the ribs; in fact, most of the weight is transmitted down the heavy A-frame at the haunch. The centers in a two-truss group are erected complete on this trestle. The weight of the steel submerges the scow about 1 ft. There is normally about a 3-ft. tide, so the trestle was built so that there would be a 1-ft. vertical clearance in floating into place

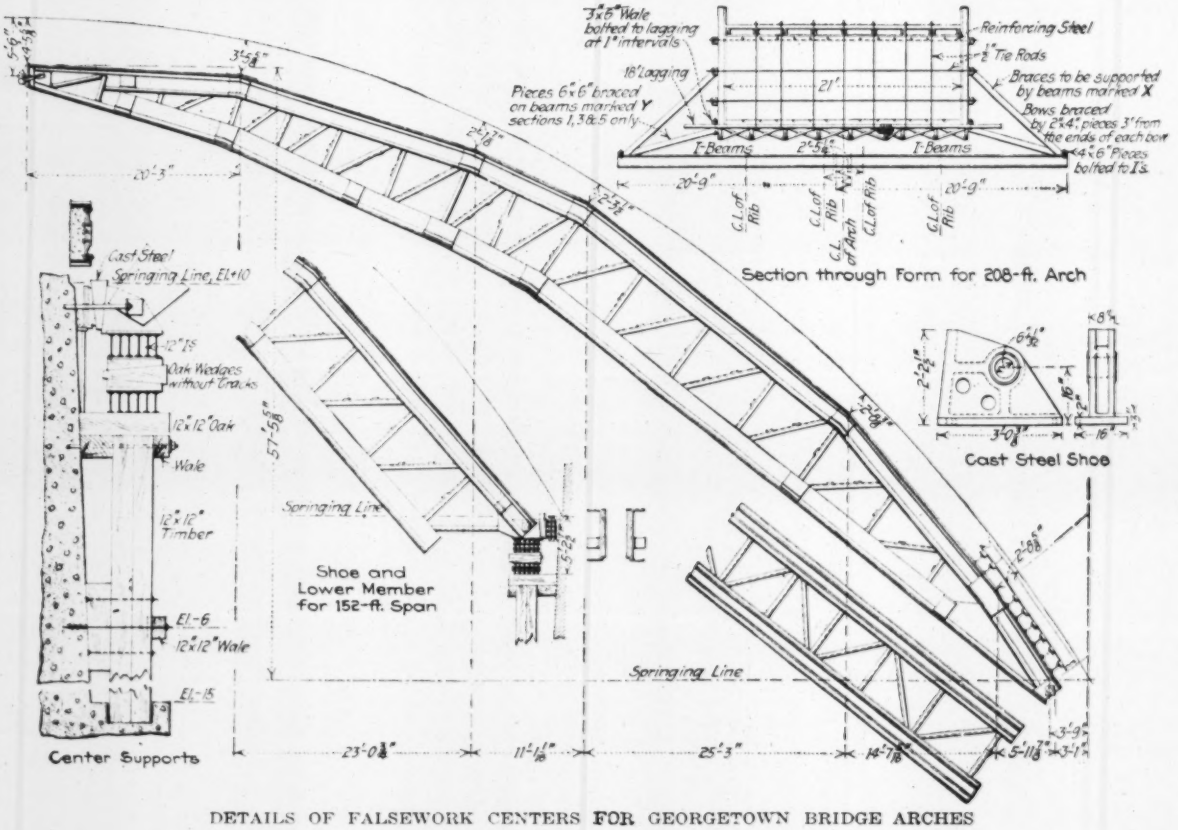


DETAILS OF 208-FT. MIDDLE ARCH

at high tide, and 1-ft. vertical clearance coming out at low tide.

In placing the centers for the 208-ft. arch the proper relation of tide and water elevation was waited for and the scow carrying the trestle for the one arch group



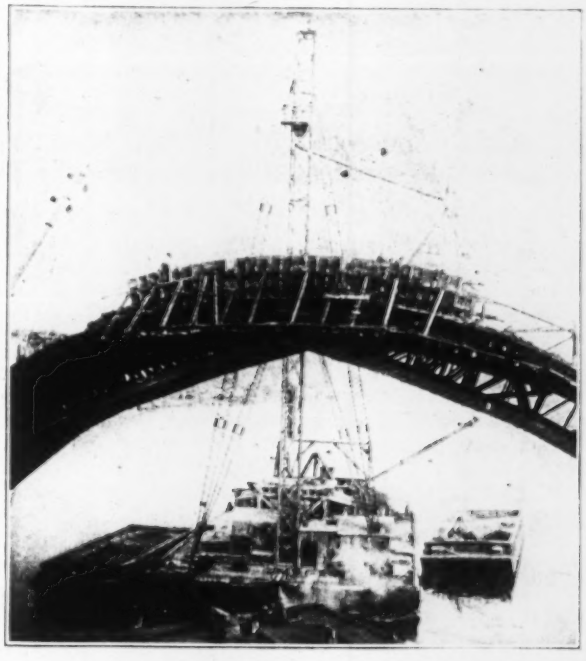


DETAILS OF FALSEWORK CENTERS FOR GEORGETOWN BRIDGE ARCHES

was floated between the piers. There was 4-in. horizontal clearance at this time and as the tide dropped the rib settled perfectly into position. The shoes at each end of the centers had to slide about 2-in. on their supports to take their seat against the wedges which had been left in place. To hold the arch in position while taking its seat with the drop of the tide, the scow was tied upstream and downstream and to the pier with cables, and in addition there were porvided 2-in. steel rods with turnbuckles extending up and down stream from the ends of the steel centers to bolts set in the piers. The latter were a great assistance, as the cables were too flexible to hold the large structure in exactly the right position. As the tide dropped the scows were readily floated away and were towed over at the Virginia side of the bridge to be used for the erection of the second set of centers.

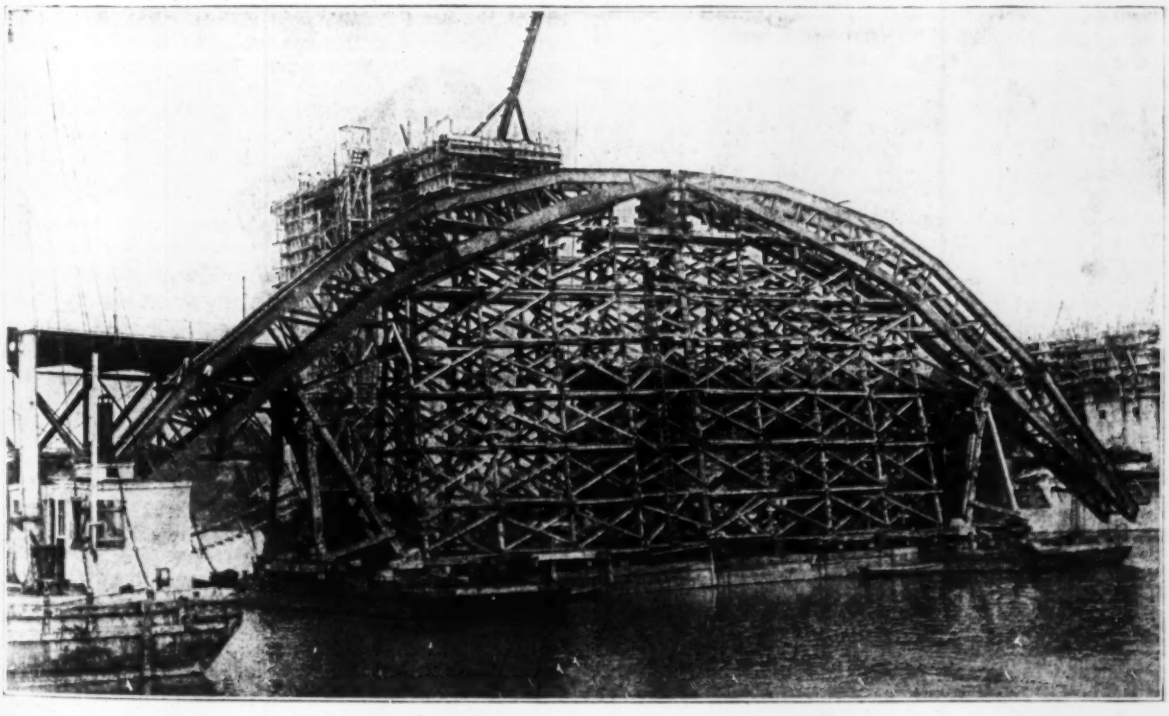
Concreting of the various piers and abutments was carried on by two separate plants. There is a cableway extending over the entire span from shore to shore and this is used for transmission of material over the entire span from shore to shore and this is used for transmission of material to the various piers. It is also used in the concreting of Pier 1 and of the north abutment from a concreting plant located inside of Pier 2 just out the District shore. In this plant material is brought in in the strip of land between the canal and the river and loaded into bins immediately over the mixer plant. An elevator tower rises between two of the shafts of the pier to a platform where buckets can be reached from the cableway.

For the river concreting the rather elaborate mixing plant shown in one of the views has been built. This consists of two large scows lashed together by completely encircling cables and by cross I-beams which carry the steel tower and counterweighted chuting equipment built by the Insley company. All sand and gravel is brought in by scow from the lower Potomac, and can be transferred directly by grab bucket to the mixing plant. Cement is brought in on the B. & O. R.R., whose tracks run under the first span.



FLOATING CONCRETE PLANT READY TO PLACE CONCRETE AT CROWN OF 208-FT. ARCH

The live load assumed in the design was 80 lb. per square foot for those portions of roadway not occupied by tracks, with both tracks occupied completely by street cars having 37,500 lb. on each axle, or 3,500



FALSEWORK CENTERS FOR 208-FT. ARCH ON SCOW

lb. per lineal foot of track. The maximum allowable stress in arch ribs, including dead and live load, arch shortening and temperature is 600 lb. per square inch. The maximum stress in steel is 16,000 lb. per square inch.

The Georgetown bridge has been designed and its construction is being prosecuted under the direction of the Chief of Engineers, U. S. Army, by the District Engineer Office at Washington, D. C. Col. C. A. F. Flagler was in charge of that office during the formative stages of the project and the preparation of the architectural plans. The architecture was designed by Nathan C. Wyeth, Washington, D. C., and was approved by the Commission of Fine Arts. Construction work was begun in August, 1917, under Col. W. L. Fisk, but since February, 1919, the work has been in charge of Major M. C. Tyler, district engineer. Major L. E. Oliver is resident engineer.

Recent Experiences with Wood Block Pavement

Analyses of Recent Failures with Suggestions as to Prevention—Pitch Coated Base Under Tightly Laid Blocks Best

WOOD blocks laid as tightly as possible on a smooth base and with a pitch filler will eliminate many of the difficulties encountered by street engineers in the past few years. This statement together with an admonition to be sure to have the sapwood fully treated by driving all air out of the wood before impregnation was made by Dr. Hermann von Schrenck in his paper on "Experiences With Wood Block Pavement" presented at the recent meeting of the American Society for Municipal improvements. The following is an abstract of the paper:

During the past two years numerous failures of one kind and another have been experienced with wood block pavements. Following periods of heavy rainfall during the summer of 1919 and at various times during 1920, wood blocks buckled and heaved and in some instances on long stretches of city streets the blocks floated away from the base. There has also been an increase in the number of cases of failure by decay of supposedly well-treated blocks. Cases of excessive bleeding have been reported, but less frequently than in former years. A case has also been reported of blocks shrinking excessively to such an extent that the blocks become loose in the streets. These failures, so far as the writer has been able to examine them, have been due almost wholly to conditions entirely within the control of the engineer, rather than to any inherent defect of creosoted wood blocks.

Timber.—Where the present specifications of the A. S. M. I. have been followed as to the kind and quality of timber a reasonably dense, satisfactory block has been obtained and few, if any, failures have been reported because of the character of the wood. In view of the failure of the sapwood of treated blocks, the writer has had numerous inquiries as to whether sapwood was not a serious defect in a paving block. Sapwood, if sound, has all the strength qualities of heartwood, and the trouble is from the treatment rather than from the wood.

Preservative.—Preservatives used during the last few years, while not always in accordance with the specifications of the A. S. M. I., have been more or less satisfactory and there has been very little complaint. Where a good coal tar product is used with a fairly high percentage of high boiling compounds failures will be few and far between, in fact, the writer has yet to see any failures of blocks due to the oil used where such oil was a pure coal tar compound.

Treatment.—The treating specifications as at present prescribed have proved satisfactory and there seems to be no reason to ascribe any of the recent failures to treatment.

Condition of Timber.—The present specification provides that "the timber may be either air-seasoned or green, but should preferably be treated within three months from the time it is sawed." Recent experiences indicate that it may possibly be desirable to put a greater emphasis upon the necessity for having timber thoroughly air-seasoned, or with a minimum moisture content. Reference has been made to failures due to decay. In 1915 the writer discussed failures in various cities due to the decay of the sapwood of treated blocks and showed that this was due almost entirely to failure to obtain proper sap penetration. The sap decay of creosoted blocks has become more evident, not only on the streets then noted, but also on many new streets. Proper lasting qualities cannot be obtained unless the blocks are thoroughly penetrated with the preservative, meaning by this at least perfect penetration of every part of the sapwood, which can only be obtained if the blocks are as dry as possible. There is no question but that many of the failures are due to the fact that the blocks were not thoroughly dry and that water pockets were still present in the sapwood, thereby preventing complete penetration of the preservative. No amount of steam treatment will make possible equitable distribution of creosoted oil in wet wood. The initial steam treatment of paving blocks is not so much to get rid of water as to assist in driving out the air, which is the principal factor causing bleeding after the blocks are laid in the street.

Inspection.—The present specifications of the A. S. M. I. call for careful inspection of the blocks after treatment by sawing a number of the blocks through the center and at right angles to the fibers. This is practically the only way to detect the extent of the penetration of the preservative.

Laying.—By far the largest number of failures of wood block paving in recent times has been due to the manner in which the blocks were laid in the streets. In the early days when more or less rough concrete foundations were used the sand cushion came into use largely to give a smooth base on which to lay the blocks. During the period of its more extensive use difficulties of all sorts arose. The blocks bulged in spots after rainfalls, and after every heavy rainfall whole street sections floated away. In many cases curbstones were thrown out of line. Another difficulty occurred due to the shifting of the sand base, giving irregular depressions and frequently holes. It has long been realized that the sand cushion was largely responsible for the swelling and the displacement. Water found its way between the individual blocks and was absorbed by the sand at the bottom of the blocks. The latter then swelled more at the bottom than they did at the top, with the resultant disturbances. In spite of the fact that these experiences are now of many years' standing many cities still use the sand cushion, notwithstanding the excellent results obtained in other cities with other methods.

Laying Blocks on Concrete Base

As a result of these experiences a number of cities adopted the plan of laying blocks directly on the concrete base either with a thin sand-cement mortar or frequently on a perfectly smooth concrete base with a bituminous coating. The first work of this sort was on Dearborn St., Chicago, between Adams St. and Jackson Blvd., put down in 1914. On the east half of the street a mortar cushion was used and the west side had a smooth concrete base with a bituminous coating. J. G. Gabelmen, engineer of streets, Chicago, makes the following report:

"The west side of Dearborn St. from Adams St. to Jackson Boulevard is in excellent condition with the exception of two cup holes. Two yards of maintenance would make it perfect. This side of the street is where the heavy trucks unload mail and should show much more wear than the east side of the street. The east side shows much more wear and is very uneven and full of depressions."

With the use of a bituminous coating on a smooth concrete base, particularly after the blocks were rolled, an

almost watertight condition obtained at the bottom of the blocks. Explosions after rainstorms, such as occurred on previous types of construction, happen very rarely, if at all, as blocks were more or less protected from water on all sides except at the top. The amount of water absorbed on the top was very small and usually disappeared rapidly by evaporation after the rain or sprinkling. There was practically no tendency for the blocks to enlarge. On the other hand, blocks thus protected lost the water content during the periods of high temperatures in summer and tended to become loose. This condition is described by W. W. Horner, chief engineer of paving, St. Louis, in *Engineering News-Record*, April 22, 1920, p. 814. In *Engineering News-Record*, Oct. 7, 1920, p. 686, Mr. Horner describes the action of one of the streets last referred to, which had been laid in the summer of 1919 after the relaying of the street first mentioned where the shrinkage had been so high.

By an ingenious method, fully described, Mr. Horner took up the shrinkage, which amounted in one case to a total of 1.3 ft. in 125 ft. After the complete closure of the blocks on this street, with terrific rainfalls coming early in September, there was not the slightest movement of the pavement in any direction. An almost ideal condition has been obtained. Blocks were protected against water at the base by the pitch coating, on all sides by the pitch filler, and the tops of the blocks, while not quite as effectively waterproof, absorbed only small quantities of water which disappeared rapidly after the sun came out. The heaving effect due to the absorption of the water at the base of the block was almost entirely eliminated.

The great trouble with wood block paving, aside from the question of bleeding, has been water, water absorption and water loss. Water absorption causes expansion which, when it takes place unevenly, as in the cases of sand cushions and frequently sand-cement cushions, brings about upheaval in the pavement and entire destruction of the street during heavy rainstorms. Water evaporation has caused loose blocks and a constantly disturbed street surface. The ideal condition is one in which the blocks are so prepared that they may have a minimum amount of water in the wood to start with and then to have them so protected that they will have little opportunity for absorbing water.

Earnings of New Zealand Government Railways

The Prime Minister of New Zealand, acting as Minister of Railways, has presented to the House of Representatives the annual statement of the Government railways for the fiscal year ended March 31, 1920. The statement shows a net profit of £1,647,420 ($8,017,169) on a total capital to that date of £39,997,340 ($194,647,055) invested in Government railway construction in this Dominion. The receipts of the 3,006 mi. were £5,752,487 ($27,994,478), as compared with £4,988,632 ($24,277,177) for the 2,993 mi. in operation during 1919, making the earnings £1,923 ($9,358) per mile during 1920, as compared with £1,670 ($8,126) per mile during 1919, with operating expenses amounting to £1,372 ($6,676) per mile during 1920, as compared with £1,107 ($5,387) during 1919.

During the fiscal year ended March 31, 1920, the New Zealand Government railways carried 12,760,814 passengers, as compared with 11,374,521 pasengers during the fiscal year 1919; 5,597,232 tons of freight as compared with 5,238,457 tons; and 403,047 head of live stock, as compared with 337,281. The train-mileage for 1920 amounted to 7,408,608, as compared with 7,477,583 mi. for 1919. At the end of March, 1920, the Government railways had 616 locomotives, as compared with 620 in 1919, 1,492 passenger cars, as compared with 1,489, and 22,937 freight cars, as compared with 22,658. —*Commerce Reports.*

Trend of Highway Development —A Survey

Minnesota Practice

THIS IS THE SECOND *of a series of staff articles on the highway situation. It deals with an extensive program of grading and gravel surfacing, with the success of a partial maintenance system and with the State's new trunk line system.*

The third article in the series will appear in next week's issue.—EDITOR.

MINNESOTA in 1920 stepped into the first rank of road building states in value of construction inaugurated. This advance is particularly notable because less than 35 miles of the new construction is hard paving. The large items are, 1,328 miles of grading and 1,129 miles of gravel surfacing. Measured in dollars, the contracts awarded in 1920 aggregate $1,168,347 for paving, $9,360,133 for grading and $4,680,066 for gravel surfacing. The price for grading includes culverts. Bridges are a separate item; they have cost $1,780,000. Altogether this new construction amounts to about $17,000,000 of which over $14,000,000 is for grading and gravel surfacing. Perhaps 15 per cent will not be completed in 1920, but the contracts brought over from 1919 and completed, will make up the deficiency and leave the amounts given very nearly a correct statement of work done.

Concentration of expenditure in 1920 on permanent grade and structures and on gravel surfacing is a continuation of the practice of 1918 and 1919. Therefore the mileages and costs which have been stated, besides expressing magnitude of operations, reflect a policy of highway development. This policy is a large mileage construction of permanent grade prior to extensive perfection of permanent grade by paving. While the mileage of gravel surfacing operations appears to contradict this policy, the contradiction disappears when it is observed that in Minnesota practice a road is not regarded as permanently graded until the final earth grade is surfaced with gravel. Perhaps qualification of this statement could be urged but it is not gross exaggeration as it stands.

Heavy Grading—In the year's grading operations, yardages and prices and not methods command attention. Heavy earthwork prevails generally. There are 10,062,804 cu.yd. on the 1,328 miles being graded or an average of 7,600 cu.yd. per mile. This is a high average for prairie state highway conditions. An average, however, does not in this instance truly indicate earthwork magnitudes: (1- Because there is a wide range between the averages for different operations, and (2- because frequently there are large yardage concentrations in short cuts and fills. Illustrating the first condition are a 13½-mile grade in Polk County on which the earthwork averages 5,352 cu.yd. per mile and a 11.6-mile grade in Hennepin and Dakota counties on which the average is 43,264 cu.yd. per mile. Between these two is an 18-mile grade in Houston County on which the earth and rock eycavation averages 16,336 cu.yd. a mile. As examples of isolated concentrations of earthwork there are, in Scott County a 1,200-ft. cut 25 ft. deep requiring 42,025 cu.yd. of excavation and in Nicolet County a 4,700-ft. fill of 82,754 cu.yd.

Dealing with these heavy yardages, grading becomes a steam shovel or an elevating grader operation, choice being determined by the character of the material and the length of haul rather than by depth or yardage of excavation. Elevating graders are the predominant equipment. Ordinarily they are team operated, but there is a limited use of tractors. Unit prices this year have averaged 58c. a yard when the grade is to be surfaced with gravel and 65c. a yard where the grading is for paving.

Gravel surfacing prices, averaged on a basis of 1,013,392 cu.yd., have been 80c. a cubic yard for hauls up to ½ mile and 95c. a cubic yard for hauls from ½ mile to 1 mile; for greater hauls than 1 mile the price has been $1.10 plus 50c. per yard-mile. Abundant gravel deposits, generally, make local pits, with short hauls, possible for nearly all road operations. Except that a less than 1½-in. gravel is used in which the material below ¼ in. is required to have a cementing value of not less than 50, the construction is usual practice.

Construction Plants Compared—Concrete paving operations present nothing unusual in methods, but some unusual output rates and two apparent indications: (1) That central mixing plants and wet batch haulage have gained increased favor, and (2) that use of materials dumped on the subgrade is not likely to be permitted in future contracts. On two operations the two remarkable output rates of 1,072 ft. and 1,098 ft. of 18-ft. pavement in one day have been made. Incidentally the higher record was made by a central mixing plant with a six-bag mixer. The maximum haul on this job has been 4¼ miles with 2-ton trucks having Lee bodies. Six-mile hauls are contemplated as entirely practicable with 1-2-4 mix having a 2-in. slump. In September the maximum day's output of this plant was 1,828 sq.yd. of 8-in. slab and the average output per *working day* was 1,111.6 sq.yd. or 556 lin.ft. In observing these records opportunity was presented by comparing for three months for about ten jobs of concreting, the maximum day's yardage and the average yardage per working day. The latter was only from 50 to 70 per cent of the former and more usually only 50 per cent.

Based on 32.69 miles and 345,516 sq.yd. of pavement, the average cost to the state of concrete paving on this years' contract has been $3.25 a square yard and $34,340 a mile. Roughly the yardage price is about a dollar a yard higher than the prices bid for 1919 contracts.

Patrol Methods.—In highway maintenance, Minnesota dates back 11 years its recognition of the patrol system. Whenever its beginning, patrol maintenance in 1920 is giving admirable results. Six-mile sections and team patrol are general practice but tractor patrol in 20-mile sections and truck patrol on 25-mile sections are also employed. Minnesota drags and blade graders are the usual equipment. The drag gives the better results when it is used faithfully and continuously but is harder on teams and men than the blade machine and the use of the latter is increasing. One reason for excellent gravel and earth road maintenance in Minnesota is the liberal expenditure practiced. This runs in some counties as high as $750 per mile of road maintained, and for the state it averages $300 a mile. Concrete road maintenance has not yet become a big problem but in the work this year an innovation has been undertaken which promises economy. It is the use of cold cut-back tar for repairing cracks. Details of the practice will be described in a future article.

Increased traffic is calling for increased maintenance everywhere in the state. In 1919 the average traffic was 1,036 vehicles of which 92 per cent were motor driven. Traffic in 1920 has mounted well above these figures; in some counties it has doubled. As a result the heavy traffic routes have called for so much attention that secondary routes of the present 12,000-mile state road system have suffered neglect. To remedy this condition an amendment to the State Constitution was sought.

Next to its construction and maintenance program, promotion of the legislation which will give the state a distinctly state trunk-line system of highways has been the most vital task of the year's work. Briefly adoption of the constitutional amendment on Nov. 2 means that the state on Jan. 1 will take over for improvement and maintenance nearly 7,000 miles of trunk highways and will be provided with money to prosecute the work from sources largely outside the present sources of highway funds.

Miami Valley Flood Protection Rapidly Progressing

Germantown Dam Will Give Full Protection and Three Other Dams Partial Protection by Next Spring

CONSTRUCTION has progressed more rapidly than was anticipated on the flood protection works of the Miami Conservancy District according to the report as of Sept. 1, 1920, of the Department of Engineering and Construction. Summarized briefly, the relocation of public utilities is rapidly nearing completion. The out-

VOLUME OF WORK PERFORMED AS OF SEPT. 1, 1920 BY THE MIAMI CONSERVANCY DISTRICT

Flood-Control Works Proper

Earth removed from cut-off trenches, outlet works, spillways and structures	877,010 cu.yd.
Loose rock, hardpan and solid rock removed from cut-off trenches, outlet works, spillways and structures	442,567 cu.yd.
Earth placed in dams	3,978,490 cu.yd.
Earth placed in levees	721,246 cu.yd.
Earth removed from river channels	1,467,327 cu.yd.
Earth moved in soil stripping and in dressing slopes with earth	181,276 cu.yd.
Earth moved in permanent road building	93,409 cu.yd.
Earth moved in sewer and drainage construction	25,242 cu.yd.
Concrete placed	144,734 cu.yd.
Clearing and grubbing	104 acres
Steel reinforcing and steel piling placed	1,446,245 lb.
Riprap placed	5,233 cu.yd.

Public-Service Relocations

Earth excavation	1,785,250 cu.yd.
Loose and solid rock excavation	713,207 cu.yd.
Concrete placed in structures	32,698 cu.yd.
Gravel placed on relocated roads	26,882 sq.yd.
Steel reinforcing placed	811,179 lb.
Track laid	47.98 mi.
Ballast placed	214,000 cu.yd.
Railway relocated	23.6 mi.

let structure at Taylorsville, the last of these great structures to be built, has been nearly completed. The local protection work at Middletown, with the exception of a flood gate and some concrete revetment, has been finished. The rivers at Germantown, Englewood, Lockington and Huffman have been diverted through the outlet works, and the dams are built across the old river beds. Noteworthy progress has been made on the difficult and tedious local protection work at Dayton and Hamilton. The sluicing has gone so well that Germantown dam is already completed, as noted in the news pages of our issues of Nov. 11, 1920, and Lockington dam will be finished in the early winter.

As a large part of the total expenditure, both of money and effort, consists of preparatory work, and of

buying and installing plant, the works are much nearer actual completion than is indicated by a statement of quantities placed. The accompanying tabulation gives the principal quantities of work done, classified under two heads, flood-control works proper and public-service relocations. This tabulation does not include preparatory work, although the quantities in the preparatory work are quite large, nor does it include considerable minor work not susceptible of classification under the general headings used.

The policy of doing the important portions of the work with the District's own forces has been continued and the concrete work and hydraulic fills at the dams and the major part of the river improvements at Dayton and Hamilton have been handled in this manner.

However, a considerable number of minor features, that do not present serious problems to the small contractor, have been let to firms of good standing, with advantage to the District. This has been especially true with respect to team work and to revetment work on the river improvements. While the total number of these contracts has been quite large, there has been expended on them to date, not including the public-service relocations, approximately $631,000, or about 5 per cent of the work done to date on the flood protection works proper.

A form of agreement has been worked out wherein the District pays the actual cost plus a fee to the contractor. This fee increases gradually as the contractor is able to reduce the cost of the work below the engineer's estimate on which the contract is based; and his fee decreases in a similar manner if the cost of the work increases above the engineer's estimate. Thus, the contractor can make a fair profit only if he handles the work economically, and the more he saves the District, the more he makes himself. This form of agreement has been entered into with contractors of known ability, and has operated in a satisfactory manner.

Outside of the flood prevention works themselves the building of the public service relocations was largely done by contract. These contracts in the main have been completed.

The total expenditures to June 30, 1920, have been $42,893,465 of which $14,783,408 were for engineering and construction.

Shoshone Project Extensions

Following a visit of the Secretary of the Interior to the Shoshone Project of the U. S. Reclamation Service possible extensions were worked up as follows at his request:

The Garland and Frannie unit could be extended to include an additional area of 15,600 acres at an estimated cost of $1,880,000. The 66,000 acres now under ditch cost $5,420,000. Three other units, Willwood, Hart Mountain and Oregon Basin, with a possible area of 15,600, 38,800 and 90,000 acres, respectively, would cost approximately $1,220,000, $3,900,000 and $8,000,000 respectively. Some storage is built for all these units but distribution or drainage works, which are the principal construction items, have not been started. The total cost for the additional 160,000 acres would be $15,000,000. To date $6,260,000 has been spent on these units, of which the greater part, $5,420,000, has been apportioned to the Garland and Frannie unit.

Freight House Floor Construction

A REALLY satisfactory floor construction for railway freight houses has yet to be designed, judging from experience with different types of floors as recorded in a report read at the recent annual meeting of the American Railway Bridge and Building Association. The life and wearing quality of the floor depend not only upon the materials and methods of laying, but also upon the traffic and equipment passing over them, as well as upon climatic and physical conditions. For these reasons, a floor that is satisfactory in one case may prove a failure in other cases. A smooth and level surface is desirable to facilitate the movement of trucks and to reduce the wear and tear of trucks and damage to merchandise. Ease of repair and renewal is an important factor in the selection.

Pine plank flooring is used more widely than any other type, says the report. Repairs can be made readily, but after the floor is worn these repairs result in an uneven surface. Hardwood floors with subplanking are used extensively, but where a concrete base is used the nailing strips for the subplanking should be of creosoted material. A heavy hardwood floor without subplanking is suggested in the report, especially for cases where water lies on the floor frequently, as decay quickly develops in double floors under this condition. No such construction by any railway is on record.

Wood blocks on concrete are said to make a smooth and resilient surface with long life and low maintenance cost, but the floor will not stand exposure to weather and repairs usually leave an uneven surface which may result in damage to fragile goods in trucking. Floors of creosoted blocks are giving good service, but are open to the objection of tainting such goods as butter and flour. Experience with asphalt floors is varied. Trouble has been experienced where temperature changes are considerable, and in damp weather the surface is likely to become sticky or slippery. Repairs can be made without difficulty. Asphalt blocks are used only to a limited extent, but in one case the blocks began to wear on the edges after 18 months' use, thus causing a rough floor. Blocks can be renewed easily, but may produce an uneven surface.

Brick floors do not seem to be desirable. Although strong, durable and sanitary, they are hard upon the truckers' feet. Further, they are noisy and being rigid they are likely to cause damage to packages in handling. On the other hand, they are recommended for damp conditions and where oils and paints are stored. Concrete floors are said to be dusty, noisy, hard on the truckers and easily damaged by falling packages; they develop temperature cracks, break up under the trucks and become worn in spots which develop into large holes and uneven surface. For these reasons, says the report, the maintenance cost is high, and the construction does not compare favorably with other floors. The wearing quality of the concrete depends largely on the coarse aggregate used and the proper mixing of the materials. Several methods for producing hard wearing surfaces have been used with varying success. Concrete laid in 8 x 8-ft. slabs has not been successful.

For economy in floor construction, the report suggests laying out aisles or spaces for trucking. Then these can be paved with the better and more expensive flooring, cheaper materials being used for the storage spaces on which there is little or no trucking.

Effect of Fire on Concrete in Warehouse at Galveston

Two Conflagrations Within Past Six Months in Buildings Filled With Sisal Teach Lessons About Concrete—Eye Witnesses Testify as to Behavior

WITHIN the past six months two fires with similar characteristics occurred in the same concrete pier warehouse at Galveston, Tex. In the earlier fire, on May 29, the destruction of the concrete structure was fairly complete in the section where the fire was localized; in the latter fire, on Oct. 2, the structural damage was confined to extensive spalling at construction joints and to floor cracking. In both fires the burning material was sisal, a Central American hemp, in bales about 4 x 3 x 3 ft., weighing about 400 lb. each and stacked, in this case, with no aisles and within 3 ft. of ceiling and walls. The earlier fire has been reported in some detail in the "Quarterly" of the National Fire Protection Association, Oct., 1920, by H. H. Sutton. The following notes on that fire are taken from that account. In addition, there are presented herewith the reports of two engineers who happened to be eye witnesses of the Oct. 2 fire.

COLLAPSED SECTION OF GALVESTON WAREHOUSE AFTER FIRE OF MAY 29, 1920

The warehouse in question is a four-section, two-story concrete building, located on the Galveston Wharf Co.'s Pier 41, which has an earth fill middle section with piled side extensions. The warehouse is 1,280 ft. long and from 100 to 300 ft. wide, and is divided by solid 12-in. reinforced-concrete walls into four independent sections, each about 300 ft. long. The structural design is simple, comprising round columns spaced 20 ft. center, carrying flat-slab floor and roof, and an outside 8-in. wall with sliding doors making up the other half of the wall area. The columns were 22 in. in diameter on the first floor, and 16 in. in the second floor, and were reinforced with vertical rods and rather widely spaced spirals as shown in the view. The second floor slab was 9 to 12 in. thick, but 9 in. where the fires occurred, with a 4-in. drop head 6 ft. square, and with column capitals 4 ft. 6 in. in diameter. The roof was 6 to 8 in. thick, with 3-in. drop head. There was no communication whatever between any adjacent two of the four sections, and a second-story outside platform prevented any communication of fire between the windows and doors of the first and second floors. Skylights with metal louvred sides and wired glass in metal frames were in the roof of each of the four sections.

The concrete, according to testimony, was good, though the exact nature of the aggregate from which it was made has not yet been made known. Information is that "the concrete was what is commonly known as a 1:2:4 mix and that both gravel and crushed limestone were used as coarse aggregate in various parts of the structure, depending upon the materials available."

The structure was built in 1915-16 by Stone & Webster, with Ford, Bacon & Davis as designing engineers.

The May 29 fire started on the second floor of Section D, which is the outermost of the four sections of the warehouse, where the baled sisal stock had been stored without aisleways to within a few feet of the roof. The rolling metal doors in the exterior walls of the section were closed and could be opened only from the inside. The fire department reached the building with reasonable promptness and soon had a large number of lines of hose playing both from shore and from fire boats. The fire fighters were handicapped, however, by the smoke caused by the preparation in which some steel cotton bale ties had been dipped and from the heavy and acrid smoke from the burning sisal. They did not get the fire completely under control for two days and it was reported that the sisal was smoldering nearly a month later. No satisfactory explanation of the cause of the fire has been advanced.

The fire continued to burn in the second story of the section where it started for nearly seven hours when the roof over the section collapsed and caused the collapse of the floor slab between the first and second floors. The collapse of the section was complete, as is shown by two of the views herewith. It is stated that the columns failed generally at a point some 6 in. below the beginning of the capital.

No sprinklers were in the building at the time and part of the recommendation for future construction of this sort is that such protection be provided.

Floors Cracked But Not Dropped By Fire

By Edmund B. Besselievre,
Consulting Engineer, New York

DISASTROUS fires in adjacent sections of the same reinforced-concrete warehouse on Pier 41, Galveston, Tex., have produced such widely differing results that the writer believes a short description of the phenomena attending these fires will be of interest to engineers.

Local conditions at these fires were in many respects identical, both fires occurring in stored bales of sisal at about the same time of the day, both were practically of the same duration and caused about the same amount of loss. The main difference was that the first of the two fires referred to, on May 29, 1920, was on the upper deck of the warehouse, while the second and most recent fire, Oct. 2, 1920, was on the lower deck.

The phenomena that will be described incidental to the fire of Oct. 2, were witnessed by the writer, who happened to be on his way to Pier 41 on official business at the time the alarm was turned in, and the investigations referred to were made during the hottest part of the fire, thus producing ideal conditions for observing the action of reinforced-concrete floors under sustained intense heat. Subsequent examinations have been made frequently since the fire was extinguished.

The fire of Oct. 2 started on the lower deck of the pier at a point about 200 ft. from the shore end of the warehouse, and was of such a serious nature as to warrant a general alarm and the presence of all fire apparatus in Galveston together with four tugs to supplement the vehicular pumping equipment.

The sisal in which the fire started was piled to within 4 or 5 ft. of the floor of the upper deck of the pier, on which was stored, in the section above the fire, quantities of linoleum and raw sugar. The smoke from burning sisal is very dense and in addition has a very pungent, irritating odor, which kept the firemen from getting to the heart of the blaze and made it necessary to fight the fire through the doors of the warehouse.

The first alarm was turned in at 8:50 a.m. and at 10 a.m. the fire was perhaps burning most intensely. At this hour the writer, who was on the upper deck of the warehouse, went into the section immediately above the center of the fire, and noticed the intense heat of the concrete floor, it being sufficient to burn the feet even through the shoes. This fact aroused in the writer's mind the possibility of the floor failing and he searched for evidences of this. This evidence was presented by the appearance of large cracks running transversely of the floor, between the rolls of linoleum. As smoke and water were issuing from these cracks it was evident that they extended entirely through the floor. Aside from this the floor for several feet on either side of the cracks was raised for a distance of between 2 and 3 in. above the normal level.

As the fire progressed the heat of the floor increased, more of these cracks appeared, as well as others running longitudinally of the building and those first observed seemed to have widened. The attention of the Fire Marshal and other officials was called to this condition by the writer and it was deemed wise to prohibit men from attempting to go into the section below this floor. Everyone of the officials who inspected the floor was of the opinion that the failure of this floor was but a matter of minutes.

However, when the fire was declared under control that same evening, the floor was still intact, with its untouched original load still on it, although the heat of

NEAR VIEW OF COLLAPSED FLAT-SLAB FLOOR, MAY 29 FIRE

the concrete had increased to such a point that the rolls of linoleum and the raw sugar stored in that section were scorched.

Observations made since the fire was extinguished and the concrete cooled show that although the cracks naturally remain, no sinking of the floor has taken place and there is no apparent weakening. Where the floor blistered and rose it has receded to approximately its original level, but the finish coat of cement is of course badly broken and the rough concrete exposed.

As stated before the original load on the floor is still there, and although this load, as nearly as the writer could ascertain, is about one quarter of the maximum allowable dead-load, stated to be 375 lb. per sq.ft., the writer believes that if the floor had been seriously damaged, this load would have been sufficient to cause its collapse. It would seem to be so from the fact that the insurance inspectors have made a careful investigation of the floor and have not ordered the removal of the present load.

In the fire of May 29 on the upper deck, the combination of nearly maximum load, with the added weight of tremendous volumes of water and the intense heat, was sufficient to cause the floor to collapse, dropping the fire to the lower deck and carrying the roof and side walls of that section of the pier with it.

The writer has been told that the reason for the collapse of the floor in this earlier fire was due to the great expansion of the bales of sisal when drenched with large volumes of water and the pushing out of the walls of the building due to this expansion. Examination of the site of this fire does not show strong evidence of any occurrence of this kind, as the remains of the walls tend to incline toward a belief that they fell inward.

Questioning of men present at this and other sisal fires and familiar with the action of that material when soaked brings forth the statement that sisal when wet does not expand to any appreciable degree. On the other hand these authorities assert that wet bales under any pressure will compress in proportion to the pressure exerted, and this contraction has been known to be as great as one-third the height of the bale. As the bales in this early fire as well as in the one of Oct. 2 were piled to a height of at least 12 or 15 ft., this contraction would have been present in all bales except those in the uppermost layer.

The writer is inclined to accept this assertion as fact, for if any substantial degree of expansion had been present during the last fire, it would have resulted in the total collapse of that section of the warehouse. The bales were packed tightly from wall to wall and to within a few feet of the floor above, and the volume of water poured into the fire was enormous, being at one time, and for a period of hours, that flowing from over 50 lines of hose under high pressure. There was little room for expansion and if there had been any the side walls would have shown it. The photograph of the exterior of the pier at the point of concentration of this last fire, shown herewith, does not show any damage to the walls other than the natural smoking and the broken window sash.

It is the writer's opinion, that considering the concentration of intense heat a few feet below the floor, and considering the length of time the floor was subjected to this heat and the continuous deluge of water, producing a great volume of steam to assist in the disintegration, the performance of the concrete was very creditable, and the fact that the floor still shows no signs of collapse and upholds its load is an indication of apparently little permanent damage.

Construction Joints Dangerous in Concrete Building Fire

By W. J. Knight,
Consulting Engineer, St. Louis, Mo.

On Oct. 2, 1920, a very destructive fire occurred in the first floor of the short compartment of the reinforced-concrete pier No. 41 in Galveston, Texas. The pier was designed and constructed a few years since, and embodied the most modern type of flat-slab construction. The compartments of the pier, several in number, are separated by reinforced-concrete walls spaced about 300 ft. apart and having an average width of approximately 120 ft. The structure is two stories high with concrete pile foundations. The columns, 20 ft. on centers, are round with the usual capitals and drops 6 ft. square and 4 in. deep measuring from the bottom of slab. The second floor slabs of the compartment are 9 in. thick and the roof slabs about 6 in. thick.

At the time of the fire the compartment was filled with sisal hemp which is used extensively for cordage and binder twine, both alone and in conjunction with manila, and is also used for bags, hammocks and similar articles. The sisal hemp was piled in bales to within about 3 ft. of the ceilings, a condition that contributed no little to the difficulty of fighting the flames.

As is evidenced by the complete destruction of the compartment the heat was very intense. The type of construction adopted in the design of this pier, supposedly offers the greatest resistence to the detrimental effects of fire, due essentially to the entire absence of projecting members with sharp corners, with the exception of drops at column capitals. A close examination of the surviving panels of floor and roof revealed complete destruction of drops, although the adjacent flat slab was more or less intact. In Fig. 00 will be noted a typical example of the condition of drops after the fire had been extinguished. The drops presented a favorable opportunity for the heat to penetrate the concrete, beginning at the outer edges or corners and continuing toward the center until destruction had been accomplished.

The round columns suffered severely from the heat and in most cases were the initial cause of failure. It was interesting to note that the presence of metal guards at the base of columns gave great protection to the concrete and the same showed evidence of little or no damage, but the surfaces of the remainder of the portion of columns, where the flames and water had free access, were disintegrated, spalled off and very irregular. The sudden change in temperature occasioned by the cool water from fire hose, no doubt was the principal destructive element, due to a state of sudden contraction from an extreme expanded condition of surface material over the underlying material of a lesser temperature. The column capitals were greatly impaired by the damaging effects of the heat which was the greatest over the ceiling surfaces.

The writer was particularly impressed by the effect of the fire on the construction joints of all slabs where these joints occur. In all cases these joints were per-

ceptible from any point of vantage from one end of the structure to the other, where the panels remained in place each of the joints being emphasized by rough surfaces of the concrete which had spalled off along both sides of it as well as by the exposure of steel bars. The accompanying photographs offer opportunity for studying a condition which heretofore has not been observed or dwelt upon, to the writer's knowledge, in descriptions of similar failures from fire causes. The compartment can be repaired at comparatively little cost, with the exception of the panels through which construction joints extend. These joints where pouring operation was discontinued until the next day, or at a later time during erection, were not specially prepared by roughing the surfaces or by any other apparent means, to insure or contribute to the bonding of new concrete to the old. Examination disclosed very smooth surfaces and the absence of any indication of bond.

SHOWING HOW SLAB PROPS SPALLED OFF AND HOW CONSTRUCTION JOINTS BEHAVED IN OCT. 2 FIRE

The joints proved to be the weakest part of the entire construction in offering resistance to the effects of intense heat, and have rendered the question of repairing a difficult one, on account of the fact that almost without exception, the portions of panels on both sides of the joints are now at different elevations, varying from 1 in. to 1½ in. and in several cases badly buckled. The accompanying photograph illustrates this much neglected feature of construction and is typical of all joints of all slabs that survived the fire. The almost universal lack of proper care and precaution exercised by engineers and builders in the past, in guarding against ineffective and insufficient bond between old and new concrete surfaces, seem to indicate that tangible reasons for correction have been lacking. This fire demonstrates beyond doubt the surprising extent of weakness developed by construction joints during exposure to great heat. From the writer's observation, the havoc wrought by such joints should be a question of universal interest to the profession, if the reinforced-concrete structures of the future are to offer to the owners and to the public the maximum degree of protection and safety and the maximum salvage in the event of fire.

The result of the fires in this warehouse has shown conclusively the great value of flat surfaces without sharp corners of any character, if the greatest protection is to be attained. The spandrel beams over door openings in the earlier fire were nearly completely destroyed, as far as future effectiveness is concerned, although the flat slab in the immediate vicinity remained nearly intact. Projecting members of every nature, such as drops at column capitals and beams, were destroyed.

These fires have also shown that piers or buildings designed for housing similar materials should have compartments much smaller in size, to lessen the great liability involved by fire. Compartments not longer or wider than 150 ft. would be more conservative.

Owing to the very inflammable nature of the contents of this pier and the comparatively few buildings used for similar purposes, a recurrence of complete destruction by fire may not be expected at very frequent intervals, but the lessons taught are invaluable for the correction of proved evils practiced in the past.

The photographs and information concerning this fire were obtained through the co-operation and courtesy of George Sealy, of Galveston, for which the writer gives due recognition.

Color of Cypress Not Related to Durability

Southern bald cypress is about the most variable in color of any of our native woods, and in different localities is known as red cypress, yellow cypress, white cypress and black cypress. There is a rather prevalent belief that cypress with dark colored heartwood is the most durable, but the opinion of the U. S. Forest Products Laboratory is that as far as durability is concerned the color of the wood makes very little difference. In service records obtained by the laboratory, any difference in the length of service of red cypress and yellow cypress appears to be due entirely to a difference in the amount of sapwood in the timbers. Cypress trees with light-colored heartwood usually have more sapwood than those with dark colored heartwood, and sapwood is not resistant to decay. The important thing if durability is desired appears to be to select the heartwood of cypress regardless of its shade.

Filter Underdrain, Sand Bed and Wash-Water Experience

Symposium on Current Practice and Operating Success with Various Details of Mechanical or Rapid Water Filtration Plants

[An attempt is made in this second installment to learn of any new devices used to scour the few inches of sand at the top of the bed. V-shaped deflectors and water jets are discussed. experience with present gutter design and spacing in relation to mud-ball formation is given. On underwater shrinkage of sand beds additional views are expressed. The first installment published Nov. 4, p. 934, dealt with perforated-pipe underdrains, gravel depths, blow-ups, mud balls and washing.—EDITOR.]

Part II. Top-Sand Scouring Devices—Gutter Design and Relation to Wash—Under-Water Shrinkage of Sand Beds

SINCE modern filter design has done away entirely with mechanical rakes to stir up the sand beds, and has largely eliminated any jet action from the incoming wash water, one naturally—and properly—turns his study to the sand surface, where most of the dirt accumulates in the first 3 to 6 in. It is this foreign material that must be separated from the sand grains, put into suspension and carried to the gutter edge. Midway between gutters is a plane of no horizontal velocity. Turbidity in the sand on this plane must travel the longest distance to a gutter. Probably the miniature mud ball is started here. It occurred to the editor that some special arrangement to accelerate the speed of the turbidity from this plane might be advantageous. Experience at Oakland, Cal., with jets at the sand surface indicated that a very small jet force only was necessary to project sand grains as well as turbidity long distances if directed with the normal rising current. Hence the idea of a V-shaped deflector to give the rising turbidity at this no-horizontal-velocity plane an initial start was conceived. The Oakland experience would seem to call for a very small initial push toward the gutter edges, much smaller than that given by a jet. The easiest way seemed to be to bend the vertical current, but how much? How large a deflector would be necessary? No one of those answering the question has had experience with such a deflector, but eight men have tried sand scouring by other means. The two questions on the subject were as follows:

10. Have you ever tried a V-shaped deflector (or a perforated pipe carrying wash water) in the plane midway between gutters to start more quickly the soiled wash water toward the gutters? If so, what shape did you use and at what elevation above the sand did you find it gave the best results?

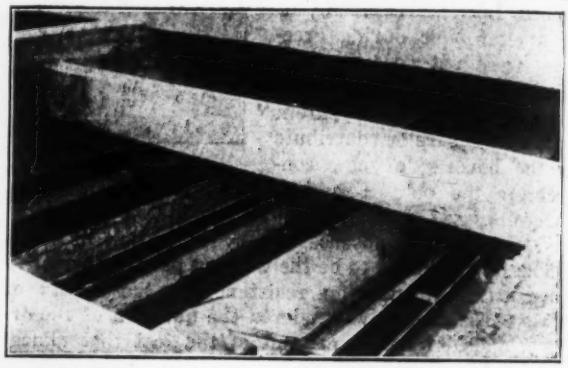
11. Have you ever tried, or do you know of any scheme other than air and the old mechanical rakes to scour the sand grains at the top of the filter? Separate water jets diverting a portion of the flow from the underdrains to the top have been suggested and used with success by the Champaign-Urbana Water Co.

Mr. Clark, Toledo — Where the distance between troughs is very much greater than in the old filters at Toledo, as also in some of the older plants of the country, I can understand that the deflector might be a distinct advantage. Even then I am inclined to believe that a spray pipe just below the plane of the tops of the troughs with lateral openings will be found more effective than a deflector.

Mr. Birdsall, Minneapolis — I have never tried the V-shaped deflector, but consider the idea a good one. Perforated pipe as an experiment has been tried without much success, possibly because of lack of proper water pressure.

Mr. Daily, St. Louis — See *Engineering News-Record*, p. 1198, June 17, where is described the use of sand washer ejectors set in a filter and left running. The wash-water valve was left open just enough to keep the sand bed fluid, hence a constant supply of sand was fed to the ejector because it sunk into the softened sand bed to the bottom. No deflectors have been tried.

Mr. Ellms, Cleveland — I have never tried V-shaped deflectors or perforated pipes, discharging wash water near the surface between the lateral gutters, to accelerate the movement of the dirty wash water to the gutters. It does not seem to me that such devices are necessary, provided the gutters are placed near enough together, and are of sufficient capacity to carry away the dirty wash water. In the two large plants with which the writer has been closely connected, the edges of the lateral gutters are 6 ft. apart. It is his impression that the waste water would be more quickly removed if these lateral gutters were placed somewhat closer together.



THE NEW TOLEDO FILTERS HAVE TREE TROUGHS

When the high velocity method of washing sand is used, the sand grains are automatically scoured as a result of the flotation of the sand bed. In fact, the writer has so often observed this phenomenon in glass filter tanks that he is convinced that no action of mechanical rakes or of separate water jets could add to the scrubbing effect obtained. The rising and the descending currents of sand under the influence of water rising at the rate of from 1½ to 2½ ft. per minute are constantly rubbing the sand grains against each other, and must of necessity remove adhering impurities which the rising wash water carries in suspension to the zone above the floating sand.

Mr. Eldredge, Ft. Worth—I have never tried a V-shaped deflector or perforated pipe in the plane midway between gutters. I have used separate water jets (operated by hand) in the top layer of sand and along the side walls of filters to assist in the cleansing. They were made of 1-in. pipe of suitable length with holes bored in the same plane. The ends were capped, connected to a water supply with 1-in. hose and used in a horizontal plane with full high pressure stream.

Mr. Buzzell, Flint—I have never tried a V-shaped deflector or any scheme other than air, water and rakes to scour the sand grains.

Prof. Hyde Berkeley—The Blaisdell tractor washer at Yuma and Calexico does not, I believe, give any trouble with mud balls from the highly turbid Colorado River water. But the character of that turbidity, due to alkali in the water, seems to be different from that in any other stream with which I am acquainted. However, this type of washer should surely prevent the formation of mud balls if anything will prevent it.

Mr. Waring, Ohio State Board of Health — It is our opinion that many of the so-called refinements are unnecessary, such as deflectors for the wash water attached to the wash water troughs, or sand catchers and special designs of sand valves to the underdrain system.

Gutter Design and Relation to Rate of Wash

So many plants have been designed with insufficient carrying capacity in the gutters that this question and three others intimately connected with gutters were propounded. Ten men answered the four questions.

12. Is the gutter design or basis for a design as developed at Cincinnati sound as proved by practice? What modifications have been found essential?

13. Are sand catchers desirable?

14. Are the gutters too often the governing factor in the permissible rate of wash?

15. Is not the minimum distance between gutters now usually allowed too great?

Mr. Sperry, Grand Rapids — We have no need of sand catchers. In the beginning we used a local sand rather than the Cape May sand specified. This was done on the certain knowledge that any sand placed would soon lose all of its characteristics as to size of grain due to the effects of the lime softening. For this reason we saved much by using a local sand of such characteristics that after some washing in place, the beds being made purposely overfull, we washed away the finer sands, leaving us very nearly the sand as specified as to effective size and uniformity coefficient. After this washing there were no sand losses.

The local gutters have been more than ample in carrying capacity. We have often wondered whether we would not reduce some of the sand coating with a much heavier wash. At present this rate is about 2 cu.ft. per sq.ft. per minute.

Mr. Clark, Toledo—Sand catchers are desirable, especially if air and water are used together for washing. The capacity of the gutters will, of course, limit the possible rate of wash, but other factors, such as size of sand, distance from normal sand level to upper edge of gutter and whether the gutters are provided with sand catchers or not, may also set the limiting rate of wash.

The tendency in this office is toward using a less distance between gutters in order to eliminate more quickly the suspended material in the wash water. It is believed that this will result in a perceptible saving in wash water. On the other hand, the upward flow between gutters closely spaced may be so great as to give trouble through loss of sand.

The drawing in the next column shows the old and new troughs at the Toledo plant. Assuming a 24-in. wash on the new filters the rise between the troughs will average 32 in. due to the lessened area. This rate is one-third greater than the 24-in. and I am inclined to believe approaches close to the danger line.

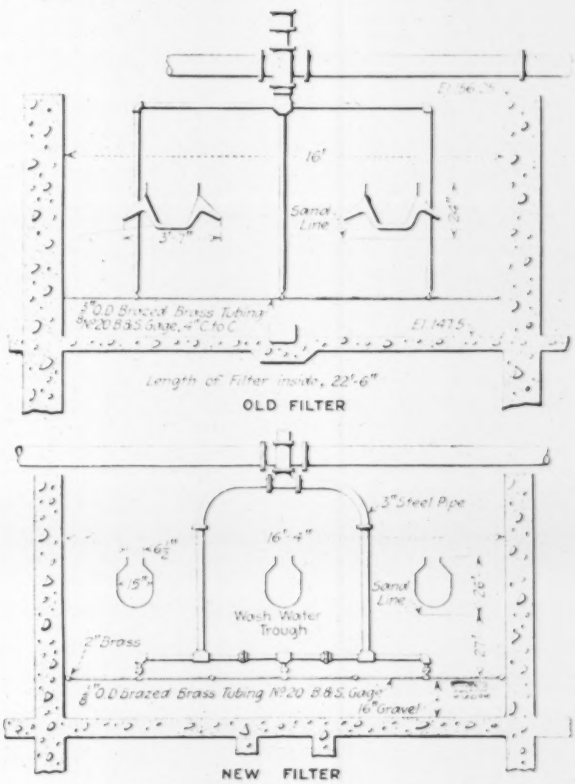
Mr. Buzzell, Flint — We are of the opinion that sand catchers are desirable and that the gutters are too often the governing factor in the permissible rate of wash. We have three gutters to each filter. (See *Engineering News-Record*, June 17, 1920, p. 1189).

Mr. Powell, Baltimore Co. — Except under unusual condition such appurtenances as sand catchers do not warrant the expenditure.

From past experience the writer is of the opinion the gutter spacing often employed is too wide, particularly so where the raw water carries a large amount of suspended matter. This condition is graphically shown on the accompanying chart plotted from our operating records. Prior to 1915 the plant consisted of two 500,000-gal. units of which each had a central wash-water trough so that during washing the water had a horizontal flow of 4½ ft. Mud-ball deposits rapidly formed along the sides and back of the filters.

In order to relieve this condition steps were cut in the front walls of the filters so that a portion of the dirty water was dischargegd into the sewer over these steps, thus creating a current along the sides of the filters. The conditions of the beds were somewhat improved by this arrangement, but the back corners still showed insufficient washing.

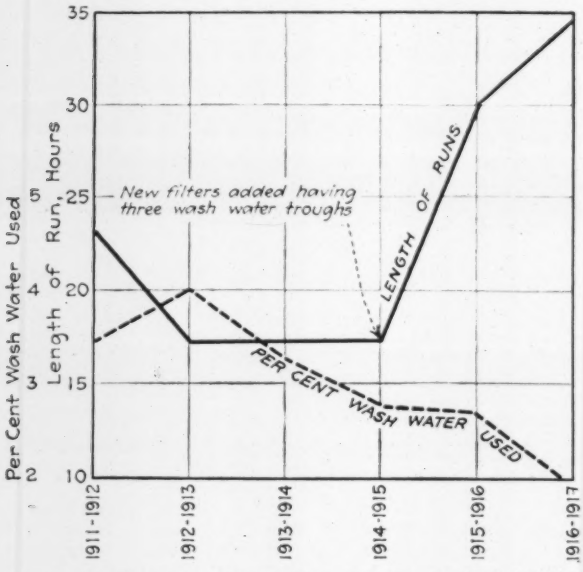
In 1915 three new units of the same size were added to the system, but three wash-water troughs were used, one central gutter of the same design as in the old units and two side ones. There was a very marked improvement in the operation of the new filters over the old ones. Mud-ball deposits were less frequent, the length of runs between cleanings was materially increased and the wash water was reduced.



OLD AND NEW WASH-WATER TROUGHS IN TOLEDO FILTERS

The same improvement has been noted at the Westport filtration plant of the Consolidated Gas, Electric Light & Power Co. of Baltimore. This installation consisted originally of three 500,000-gal. units, each having a central gutter, the wash water traveling 4½ ft. horizontally. Two new units were designed with side troughs in addition to a central gutter. Fewer mud balls formed on the filters with the side troughs and better operation has been effected. The horizontal flow of water in the new filters is approximately 2 ft.

Mr. Birdsall, Minneapolis — The design is adequate. No modifications have been made other than to increase the number of troughs. The floor and the central collecting gutter is raised at the rear end of the filters and sloped toward the sewer end to save the wedge of water that would be lost each time that the filter is washed. Sand



THREE WASH TROUGHS AT BALTIMORE COUNTY PLANT IN PLACE OF ONE INCREASE RUN AND REDUCE WASH WATER

catchers are not needed at Minneapolis. The Minneapolis gutters have ample capacity.

Yes, the minimum distance between gutters is too great ordinarily. The new Minneapolis filters have nine instead of eight lateral gutters in each half filter. I would increase the number of gutters in future filters.

Mr. Daily, St. Louis — Sand catchers are not desirable with a properly designed filter. See answer to mud-ball question with reference to gutter spacing.

Mr. Ellms, Cleveland—The writer can see some advantage in the use of sand catchers on lateral gutters. Any extension from the side of the gutter in the form of an angle or of wings cuts off vertical currents rising along the side of the gutter. The zone above the projecting wings, therefore, is only subject to the horizontal currents, which, without the assistance of the flotation effects of the vertical currents, will probably not carry the sand into the gutters.

The writer is of the opinion that wash-water gutters are frequently too small. There is no doubt that the permissible rate of washing is limited by the carrying capacity of the gutters.

C. N. Miller's formula for determining the size of the wash-water gutters is undoubtedly conservative. Some observations made at the Cleveland filtration plant show that the central gutters in the tanks at this plant closely approximated the size as determined by the formula. This formula is designed to cover a condition where there is no free fall at the discharge end of the gutter. It was found in the central gutter of the Cleveland plant filter tanks, when washing at a rate of 27 in. per minute and where the outlet was submerged, that the cross-sectional area of the water in the gutter was only 3.5 per cent less than that called for by the Miller formula. The discharge from the lateral gutters falls freely into the central gutter, and Mr. Miller is careful to state that under such conditions his formula provides for a larger gutter than is necessary. In the case of the Cleveland filter tanks, the cross-sectional area of the water in the lateral gutter was found to be 76 per cent of that calculated by the Miller formula.

Mr. Eldredge, Fort Worth — I have never used sand catchers, but from the loss of sand in some plants would think them highly desirable.

The gutters are too often the factor governing the permissible rate of wash.

The minimum distance between gutters is too great. The additional first cost is soon recovered by the saving in wash water as well as in the advantage of a better wash.

Prof. Hyde, Berkeley—The gutters are too small at Harrisburg and at many other places. At Sacramento we propose ten gutters in a length of about 58 ft. This will place them 4 ft. 10 in. apart in the clear. Ordinarily the minimum distance apart has been too great.

Mr. Lovejoy, Louisville — My experience has been that sand catchers are not necessary if the filter design is right. I believe the gutters are too often the limiting factor in the permissible rate of wash.

It is my opinion that 6 ft. should be about the maximum distance between gutters, making a maximum travevl of 3 ft. each way.

Under-Water Shrinkage of Sand Beds

The day of colloids is here and the theory of the predisposition of many liquids to gel when small quantities of certain foreign matter are added has opened a world of conjectures in the minds of those chemically inclined. Abel Wolman and S. T. Powell presented in *Engineering News-Record*, July 29, 1920, p. 210, an explanation of under-water shrinkage of sand beds. Their contention is that various sands have different colloidal properties and sand should be chosen with low gel property. The questionnaire was sent out previous to the appearance of the paper although the editor had seen it. Eight men answered the one question but the experience of Messrs. Daily and Ellms has been given in the general discussion of the Wolman-Powell paper in *Engineering News-Record*, Sept. 2, p. 438.

16. Have you had any experience with the under-water shrinkage of sand beds away from the side walls? Maryland engineers have made an exhaustive study of the phenomenon and set up a theory attributing the action to colloids forming a gel which contracts the bed.

Mr. Clark, Toledo — Under-water contraction has been experienced only when softening was being done and has been attributed in part to magnesium hydrate and organic material adhering to the sand grains.

Mr. Birdsall, Minneapolis—Yes, the shrinkage has been noted. I believe the theory of the Maryland engineers is correct. The formation of jelly-like deposits along the side walls of filters at Minneapolis is attributed to the fact that holes in the strainer plates do not extend up to the side walls because of the concrete shoulders on which the ends of the strainer plates rest. I would change this design in future filters.

Mr. Eldredge, Ft. Worth — In most cases under-water shrinkage of sand beds was relieved when the filters were getting a properly treated water. Overloading the filter with "floc" has often caused such cracks to appear. On draining such a filter it usually shows low in the center.

Prof. Hyde, Berkeley—At Sacramento we propose to overcome any difficulties of this sort by battering the inside walls of the filter units.

Mr. Lovejoy, Louisville—We had trouble with shrinkage of the sand beds away from the side walls in our old filter units until we removed the holding-down screens. We also had trouble with the sand caking with mud for 2 or 3 in. from the walls. Both of these troubles have disappeared since we removed the screens. My theory is that there was a lack of wash-water velocity close to the side walls, due to the fact that the mesh of the holding-down screen was more or less stopped up with concrete near the walls, thus diverting the water away from the wall during washing. This clogging of the screen also would tend to make the area of sand close to the walls a dead area during filtration, due to this sand having been caked with mud from lack of washing. This condition would tend to pull the sand away from the walls toward the center of the filter where the greater suction existed. The suction or downward pull on the sand bed is an appreciable factor in filters operating on negative head as in our case.

Mr. Waring, Ohio State Board of Health—To overcome the tendency of sand beds to shrink away from the side walls, J. M. Rice of Morris Knowles, Inc., has suggested in the design of the Elyria, O., plant battered side walls below the sand line. Experience in Ohio is lacking on this phenomenon.

State Hydro-Electric Development for South Dakota

Engineer's Report on Project to Distribute Power From Missouri River Over 1,200 Miles of Transmission Lines

POWER development and supply by the State of South Dakota by means of a hydro-electric plant on the Missouri River at Mobridge, S. D., with distribution over transmission lines covering a large area of the state, is discussed in a recent report to the State Hydro-Electric Commission by D. W. Mead and C. V. Seastone, consulting engineers, Madison, Wis. This report is the result of an investigation of the possibilities of power development on the Missouri River, following the passage of an amendment to the state constitution to provide for state ownership and operation of power plants. In February, 1919, Governor Norbeck appointed the State Hydro-electric Commission, under whose direction the investigation has been made.

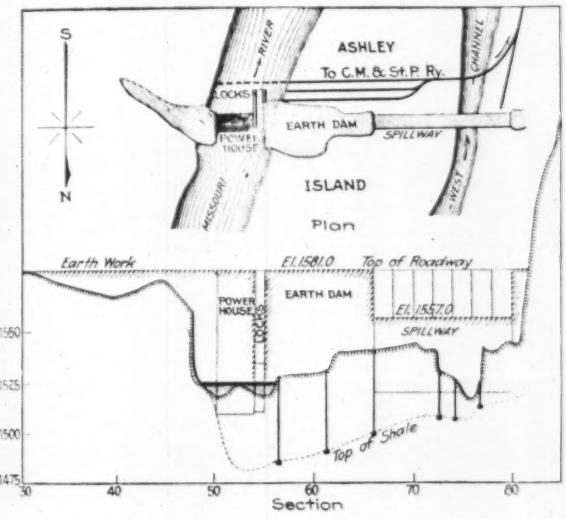


FIG. 1. PROPOSED HYDRO-ELECTRIC PLANT ON THE MISSOURI RIVER AT MOBRIDGE, S. DAK.

Eight sites for power development were studied, the best of which is about four miles above Mobridge, where the minimum continuous output would be about 16,000 hp. A plan and section of the proposed works are shown in Fig. 1. It is stated in the report that if this project should be undertaken at once, it can be completed probably by 1925. The estimated cost is $9,103,000 for the power plant and $7,044,000 for the transmission system, but if secondary transmission lines and substations are built by the various communities the total cost to the state might be reduced to about $13,900,000. Transmission lines would serve mainly the more populated eastern part of the state. In this section the market available in 1919 offered a load of 30,000,000 kw.-hr. per annum now developed from fuel and this market may increase at about 10 per cent per annum by the encouragement affected by cheap power.

Cost of power from fuel at various plants in the state varies from 1.7 to 10c. per kw.-hr. if based on entire station charges, or from 1 to 5c. per kw.-hr. if based on fuel costs only. With the entire output of the proposed hydro-electric plant sold, about 87,600,000 kw.-hr. per annum, power can be developed at this plant at a unit cost of 1.60c. per kw.-hr. If the state pays the entire cost, or 1.34c. if customers furnish the secondary transmission system. Charges of 1.87c. or 1.67c. per kw.-hr. respectively, would give a profit above fixed and operating costs and these prices could be increased fairly with the gradual rise in fuel prices.

For the first five years, however, these prices for the present available market would not produce sufficient to pay interest and operating expenses or depreciation charges, but a further investment of $1,500,000 would be required temporarily to meet the unearned interest. When the market increases to 53,000,000 kw.-hr. per annum the income would pay interest and operating charges, and with further increase in consumption of current it would gradually retire the development fund, establish a depreciation fund and begin to retire the capital costs. If the market should develop to 53,000,000 kw.-hr. per annum before the plant is completed, the additional $1,500,000 would not be required.

Proposed Developments

If the market should warrant the investment the Mobridge plant could be developed for a 40-ft. head at an additional cost of $2,300,000. With the resulting total output of 117,000,000 kw.-hr. per annum marketed the unit cost of current would be reduced to 1.35c. per kw.-hr. As an alternative a second plant could be constructed at the Mulehead site, near the southern boundary of the state. With both plants working at 30-ft. head and selling their entire aggregate output of 200,000,000 kw.-hr. per annum the unit cost of current would be about 1.2c. per kw.-hr. per annum.

That the state can afford to undertake the Mobridge development with every prospect of financial returns to maintain and ultimately liquidate the investment, is the general conclusion of the report, provided that a growth of 10 per cent per annum for the power market can be anticipated with good reason. It is pointed out, however, that such results can be attained only by conservative financing, economic construction and scientific management, under intelligent administration free from political interference.

As to private enterprise, the report states that in view of the high cost of development and the great length of transmission to reach the limited market, the returns would be too small to attract private capital. Only that part of the state east of the Missouri offers a market for power at present, and even there the scattered locations require a comprehensive and costly distribution system. In fact this system will cost almost as much as the development plant. In that section of the state are 29 towns or groups of towns which in 1919 had an aggregate power consumption of 38,467,000 kw.-hr. per year.

The average and minimum flow at Mobridge including the effect of pondage by the dam, is estimated at 10,000 and 4,100 sec.ft., equivalent to 25,000 and 16,000 hp. continuously at the turbine shaft under 30 ft. head.

A flood flow of 100,000 sec.ft. may occur perhaps once in five years and last for three or four days. A high flood of 180,000 sec.ft. has occurred only once since 1892.

At the selected site the low-water flow is divided by an island between the main channel and a side channel. The proposed layout includes a power house 384 ft. long across the main channel, with an adjacent lock 60 x 350 ft. having 7 ft. of water on the lower miter sill. Next to this will be 1,200 ft. of earth embankment with concrete core walls, followed by a 1,400-ft. concrete dam and spillway extending across the island and the smaller west channel. A cut-off of steel sheeting would be driven into the underlying shale stratum for the entire length of the structures, the maximum depth of this shale being through 50 ft. of silt in the main channel. The spillway crest is at El. 1,557 and the roadway and top of earth embankment at El. 1,581.

By placing the spillway at the west end, it is located where the shale comes within 5 to 25 ft. of the river

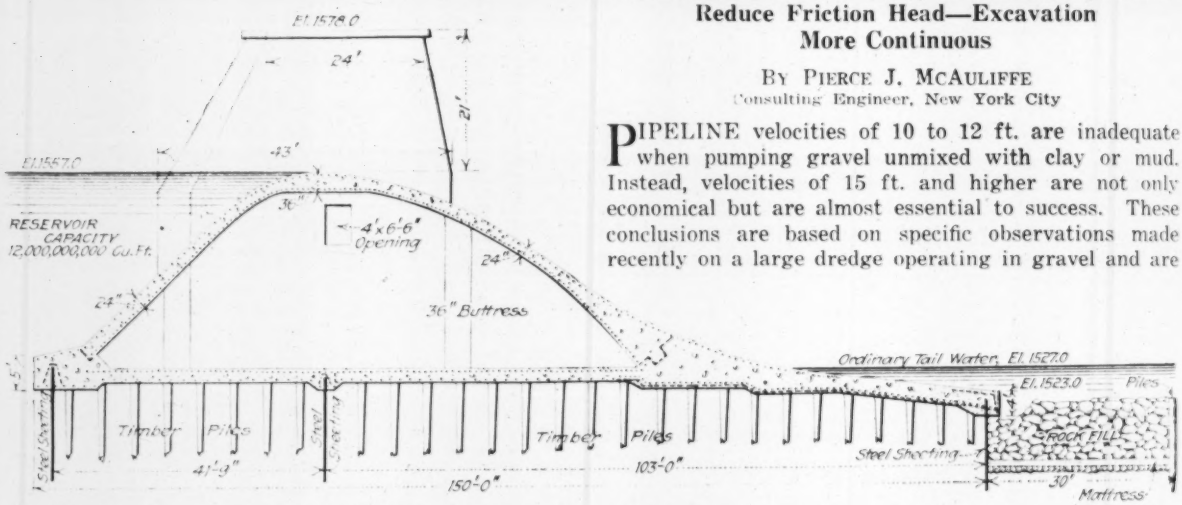


FIG. 2. SPILLWAY OF DAM FOR HYDRO-ELECTRIC PLANT

bed. The power house and lock are placed in the main channel in order to provide a free flow from the draft tubes and to assure a low-water navigation channel in the tail water. Silt is not expected to have any serious effect in reducing the capacity of the pound or in causing erosion of the turbine blades. The power estimate is based on the normal flow and not on storage and it is believed that the annual floods will keep the channels secured sufficiently to supply the limited storage necessary to supplement the ordinary deficiencies of flow.

A hollow dam of reinforced-concrete is proposed for the spillway, as shown in Fig. 2. This would have the deck supported by 36-in. buttresses or walls spaced 12½ ft. c. to c. Two lines of steel sheeting 10 to 30 ft. long are provided under the upstream side of the dam, a third line of sheeting under the toe of the downstream apron will be a protection against back scouring and may help to prevent the development of uplift pressure on the dam during abnormal height of tail water. Beyond this concrete apron is a boulder fill 30 ft. long, resting on a brush mattress and retained in position by a line of timber piles. With a rise of 21 ft. of water over the crest the spillway would have a discharge capacity of 500,000 sec.ft., which is 60 per cent in excess of the greatest discharge known at this point. Ten vertical shaft turbines of 6,000 hp., directly connected to ten generators of 5,400 k.v.a. would be the main power house equipment. Alternating current generated at 6,600 volts would be transformed to 110,000 volts for delivery to the transmission lines. This would be stepped down to 33,000 volts for distribution to the smaller towns and villages. Twelve substations are provided for, spaced from 30 to 100 miles apart. The main transmission line system would aggregate 560 miles and the secondary system 600 miles.

This report was considered by the Special Water Power Committee at a special meeting of the state legislature in June, but final consideration was deferred until the regular meeting to be held in February, 1921.

Pipe Line Velocities Necessary to Transport Gravel

Small Increases in Velocity Increase Output and Reduce Friction Head—Excavation More Continuous

By Pierce J. McAuliffe
Consulting Engineer, New York City

PIPELINE velocities of 10 to 12 ft. are inadequate when pumping gravel unmixed with clay or mud. Instead, velocities of 15 ft. and higher are not only economical but are almost essential to success. These conclusions are based on specific observations made recently on a large dredge operating in gravel and are confirmed by general experience with many pumps handling all varieties of materials. On several occasions these conclusions have been put to test, with gratifying results, although, in some instances where horse power and not peripheral speed of the runner was the limiting factor, it has called for the seemingly paradoxical action of decreasing the diameter of the entire pipe line to obtain greater output.

In the specific observations referred to, the dredge has a 20-in. suction and discharge pipe. The pump, using a 90-in. runner, is directly connected to a 1,000-i.h.p. engine (17 in. and 27½ and 42 in. x 20 in.). At a speed of 205 r.p.m. the engine has shown 1,015 i.h.p. The boilers are of ample size to maintain steam pressure at 200 lb., even when burning hard coal screenings. The condenser vacuum is held quite steadily at 25 in. The auxiliary machinery has been performing satisfactorily during the eight years that the dredge has been in operation. The crew and operation were excellent.

During the observations, the dredge was engaged in digging a channel where a large portion of the material consisted of coarse sand, heavy gravel and some stones which would not pass through a 10-in. ring. The pipeline varied in length from 1,800 ft. to 3,700 ft. and

eventually it will reach a length of 5,500 ft. The elevation from water level in the channel to the center of the end length of discharge pipe varied from 8½ to 14½ ft., depending upon the tide.

Discharging through 2,400 ft. of pipe, Fig. 1 shows the stream and Fig. 2 indicates the character of the material. Excepting the large stone the material was sand and gravel under 1 in. in size. The discharge velocity caught by Fig. 1 was about 12 ft. a second and the stream was carrying as much solid material as could be handled without choking.

Simultaneous gage readings taken at the moment the picture was snapped showed the pipe suction to be 12 in.

FIG. 1. DISCHARGE THROUGH 2,400 FT. OF PIPE; VELOCITY 12 PER SEC.

FIG. 2. MATERIAL DISCHARGED BY STREAM SHOWN IN FIG. 1

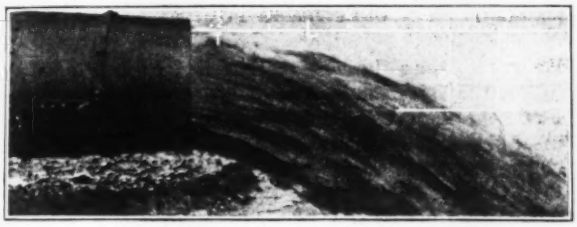


FIG. 3. STREAM FROM 3,400-FT. PIPE LINE; VELOCITY 10½ FT. PER SECOND

FIG. 4. MATERIAL DISCHARGED BY STREAM SHOWN IN FIG. 3

and the pipe line pressure to be 64 lb. Corrected for gage location and static head of discharge, the friction totaled 131 ft. head; equivalent to 6 ft. per 100 ft. of discharge pipe. The dredge delivered an average of 120 cu.yd. per hour actual operating time. The discharge stream was, therefore, carrying an average of about 3½ per cent of solids. The important feature is that with this velocity of discharge the operator was unable to feed material into the suction constantly. The cutter was turning over at as low a speed as possible consistent with steady revolutions. Only sufficient strain was put on the swinging wires to pull the cutter into the material slowly. After digging for 45 to 50 min. at this rate, the operator would find it necessary to stop his cutter and swinging engine for about 10 min. in order to pump water so that the surplus material which had been taken into the pipe, but which could not be kept moving, could be picked up again and discharged. In other words, 16 to 20 per cent of the running time was fruitless as far as sucking up solids was concerned. On this score alone, a dredge, which would have delivered 400 cu.yd. per hour of mud or clay, would have its capacity cut to 320 cu.yd. per hour when it encountered material such as shown by Fig. 2. In addition, as the swinging and cutting speeds were less than half the normal, the output would be further reduced by at least 50 per cent. As this particular dredge had experienced no difficulty in delivering over 600 cu.yd. of mud and clay per hour through pipe lines of equal length, the owner might have taken the contract at a figure far too low if he had not understood the difficulties presented in moving heavy gravel.

Discharging through a 3,400-ft. pipe line, Fig. 3 shows the stream and Fig. 4, the material. On the dump the composition was estimated to be 60 per cent clean sand; 15 per cent ¼ to 1½ in. gravel; 20 per cent 1½ to 4-in. gravel, and 5 per cent stones over 4 in. in size. The engine was making 210 r.p.m.; the pipeline pressure registered 65 lb., and the pipe suction was 8 in. The friction developed in each 100 ft. of discharge pipe was equivalent to 4.4 ft. head. The writer estimated that the velocity on the basis of a full 20-in. pipe would have been 10½ ft. per second. The average output per hour under these conditions was 85 cu.yd.; the percentage of solids in suspension was, therefore, 2.84 per cent. The operator found it necessary to pump clear water for at least 20 min. after feeding as slowly as possible for a period of 35 to 40 min.

As the amount of work in view did not warrant the installation of a booster, it was decided to install a larger runner to meet the conditions imposed by the necessity of longer pipelines. A 96-in. runner was installed. The pipeline was 3,560 ft. long and the elevation the same as for the previous observation. The engine speed was from 198 to 202 r.p.m. and it was undoubtedly developing very nearly 1,000 i.h.p. The material, shown by Fig. 5, was entirely sand and gravel. A larger percentage of stones above 2-in. size was present than in previous observations.

Fig. 6 shows the discharge under normal operating conditions. The horizontal offset of the upper curve of the discharge stream was 3.75 ft. where the vertical coordinate was 1 ft. Using an arbitrary factor of 0.92, which the writer has selected after numerous rough checks, the average velocity of discharge was found to be 13.8 ft. per second.

One hundred fourteen hours actual operation produced an average of 110 cu.yd. per hour, or 34 per cent over results obtained with a 90-in. runner under similar conditions. The pipeline vacuum and pressure gage recorded 9 in. and 66 lb. respectively. The friction per 100 ft. of pipeline was slightly over 4 ft. The percentage of solids carried was about 3.6.

FIG. 5. LARGER PERCENTAGE OF STONES ABOVE 2-IN. SIZE WHEN 96-IN. RUNNER USED IN DREDGE PUMP

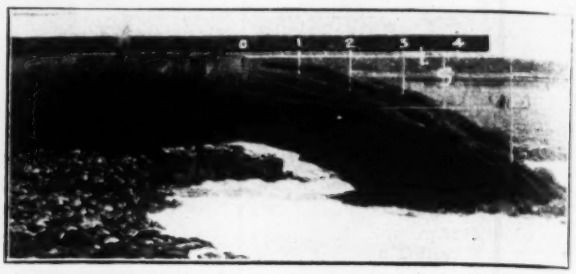


FIG. 6. VELOCITY OF 13.8 FT. PER SECOND—DISCHARGE OPERATING NORMALLY

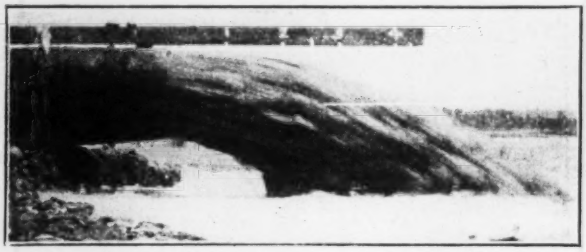


FIG. 7. VELOCITY 16.2 FT. PER SECOND; STREAM HEAVILY CHARGED WITH SAND

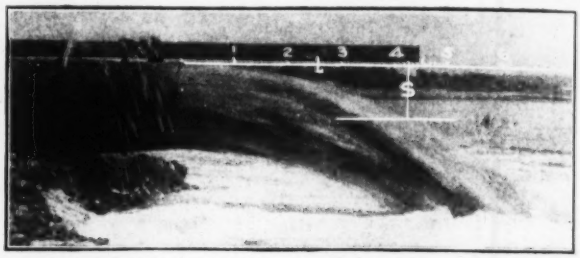


FIG. 8. VELOCITY 15.6 FT. PER SECOND; WATER ONLY BEING PUMPED

Since the material was moving briskly throughout the entire pipeline, it would appear that the saturation point for this velocity of discharge in a 20-in. pipe, when carrying material shown by Fig. 5, is about 4 per cent of solids. The lower friction head is probably accounted for by the fact that the material was all in suspension throughout the line, so that no congestion of solids occurred at various points, which was probably the case in the two previous observations. The solids were of course traveling in the lower part of the pipe at a velocity considerably less than the average of the mixture.

Shortly after Fig. 6 was recorded the operator was signalled to stop excavation but to continue to pump water. It required 8 min. 20 sec. before all solids had been discharged from the pipeline, which, with the suction pipe, totaled 3,660 ft. The velocity of discharge increased slowly at first until it reached its maximum at about the time Fig. 7 was taken. This was 7 min. 10 sec. after digging had ceased. This picture shows the stream heavily charged with sand, as is made quite evident by the shape of the lower curve of the discharge.

The time interval was too short to make any but the roughest check on the percentage of solids carried at this maximum velocity, but the bottom section of the pipe for a depth of 6 in. was filled with a rapidly moving stream of sand. If we consider that the voids in this stream of sand represent 50 per cent of its volume, a cross-section of the discharge would have shown over 12 per cent of solids in suspension, from which it is evident that the capacity of a stream in carrying solids increases rapidly with relatively small increases in velocity and explains why dredge operators maintain high velocities when possible.

After the pipe was entirely cleared of sand and stone, Fig. 8 was taken. Attention is drawn to the difference in the shapes of the lower curves in Figs. 7 and 8. In the latter the arcs of the upper and lower curves are apparently parallel, while it is evident that the sand in the lower half of the pipe, Fig. 7, was traveling at a lower rate than the water above it. After Fig. 8 was taken, the operator was signalled to resume digging. From the instant the cutter encountered solid material until the first discoloration of the discharge appeared at the end of the pipe, 4 min. 10 sec. elapsed, showing that the average velocity through the discharge pipe during that period was 14.66 ft. per second.

Upon resumption of digging, the operator continued to feed solids into the suction at the customary rate. It is, therefore, probable that the discharge stream was saturated for at least one-half of its total length by the time the first discoloration appeared at the end, and that we are reasonably correct in supposing that the velocity found by this test was a mean between that shown when dredging normally and that found when pumping clear water only. If we put this to test it will be found that it agrees quite closely with the mean of the velocities of 13.8 ft. and 15.6 ft. per second as estimated from Figs. 5 and 8, respectively. No effort was made to bring these figures into agreement. It was only as an afterthought that some relation between the two was looked for.

Another point of interest is, that it required exactly double the time to clear the pipe of all solids that it took for the first appearance of solids to show again after the pipe had been cleared, which would seem to indicate that the velocity of the solids dragging along the bottom of the pipe was about one-half the average velocity of the total discharge.

Wisconsin Doing Much Highway Bridge Work

During 1920 a large amount of highway bridge construction was initiated in Wisconsin under supervision of the State Highway Department. Plans were prepared by the department for 540 bridges, totaling in length 15,315 ft., and to cost 2¼ million dollars. About half the total represents state-aid work, and only about one-seventh Federal-aid work, the remainder being county construction. The figures given cover only the first three quarters of the year.

Nine Years' Operation Results of the Municipal Garbage Reduction Works at Columbus, Ohio

City Reports Show Surplus for Each Year Except 1919, but Taking All Factors Into Account There Is a Deficit That Makes Net Cost 46 Cents a Ton Without Interest and 87 Cents With Interest

By James W. Follin
Engineer, Bureau of Municipal Research of Philadelphia

TEN years' operation of the municipal garbage reduction works at Columbus, Ohio, was completed on July 20. An analysis of the financial results for the nine calander years 1911 to 1919 is here presented. This plant has been of especial interest to engineers and municipal officials because it was the first municipally constructed and operated reduction plant. Frequent reference has been made to the Colmubus solution of the garbage disposal problem as worthy of emulation in other cities, and the plant has been visited extensively by engineers and laymen.

Until operating results from the Columbus plant were published, no reliable records were available concerning the expense and income from garbage reduction except those from the Cleveland plant, which had been purchased from a private company about 1905. When the first reports from Columbus indicated a surplus of production income over plant operating expense, the result was hailed by many as pointing the way to the general solution of the garbage disposal problem in furnishing a method not only providing disposal with dispatch and under conditions acceptable to all but the most fastidious, but also one actually returning a profit. Advocates of municipal operation also received these early reports with much interest and considered that they dispelled the fears that a municipality could not advantageously operate a plant which called for expert supervision and which had been almost entirely owned hitherto by private companies.

Several analyses of the operating results made by engineers soon after operation began served to correct in some degree the popular impression that the plant was making large profits. In these analyses freight and depreciation charges were added to the cost of disposal, while interest charges were also deducted from the indicated surplus to afford a comparison with privately owned plants. In connection with a survey of the city government of Columbus in 1916, the Bureau of Municipal Research of New York analyzed the plant operation and indicated an excess of receipts over operating and fixed charges of only $12,575 for the five years 1911 to 1915 and the first ten months of 1916. Operating expenses did not include a charge for water supplied from the city mains after 1912. It was estimated that water was used at a rate of 20,000,000 cu.ft. per year, which at 80c. per 1,000 ft. would total $81,350 for the period covered. Including this latter amount in the operating expenses the plant showed a net loss of $68,775 to Nov. 1, 1916.

The annual reports of operation have shown a surplus of production revenue over plant operating expense for each year of operation except for 1919, when a deficit of $20,899 is given. The 1919 report was doubtless received with disappointment by those who had misconstrued the record of operation previous to 1919 and who had thought that the plant was making an actual profit on the disposal of garbage.

Description of Plant—The Columbus plant was described in detail in articles which appeared soon after operation began, and it is unnecessary to repeat this detailed description here. (See *Engineering News*, Nov. 17, 1910 and *Engineering Record*, Nov. 19, 1910.) The garbage is cooked by live steam in 10-ton sealed steel digestors. The liquids are pressed from the cooked mass and flow to tanks where the grease is separated from the stick liquor, which is reduced by evaporation and added to the dried solids from the presses. Originally the latter mixture was dried and sold as a fertilizer base without further degreasing, but in January, 1912, a percolator plant was put into operation. After percolation with gasoline, the tankage is again dried and then screened. Some of it is sold in this condition, but acid phosphate is added to another portion and the mixture is sold directly as a fertilizer.

The most important change in the plant equipment has been the substitution of direct-heat dryers for the steam-jacketed dryers initially installed.

The original investment in the building and equipment was about $185,000, but adding the cost of the land, railroad siding, steel tank cars and engineering, the total reached $236,881. About $26,000 additional was spent for the percolator plant. In making allowance for depreciation charges in this analysis, depreciation has been figured at 5 per cent per annum, in accordance with former reports on this plant, on an investment of $236,881 in 1910 and 1911, and of $262,881 from 1912 on. A straight depreciation charge on the entire investment is necessary in view of the non-availability of information with which to classify the investment details. Yearly interest charges in this analysis are figured at 4 per cent on the depreciated value of the plant, and not on the full investment.

Detailed Analysis of Operation—In Table I is presented a compilation of information on garbage collection and disposal taken from the annual reports, where available, and from other sources. Since a record was not obtainable for the portion of the year 1910 in which the plant operated, the table begins with the year 1911. To facilitate comparisons from the table, the percentage of increase or decrease in each item is shown between the year 1916 and each of the years 1917, 1918 and 1919, and finally between the years 1918 and 1919.

The tonnage of garbage collected increased steadily from 1911 to a maximum in 1915, but had fallen off about 5 per cent in 1916 before it took a 22 per cent drop in 1917 and declined still lower in 1918—just as the quantity of garbage collected in practically all cities decreased during the period of the war. In 1919 the collection increased 16 per cent above the 1918 quantity. The high point in 1915 represented a maximum per capita collection of 218 lb. for the year, while a minimum of 142 lb. per capita was reached in 1918. The increase in collection in 1919 raised the per capita figure to 153 lb.

Table I—Detailed Analysis of Operation of Columbus, Ohio, Municipal Garbage Reduction Plant, 1911-1919

Plant put into operation, July 20, 1910. Percolator plant in use, January, 1912

Item	1911	1912	1913	1914	1915	1916	1917	1918	1919	Percentages of Increase or Decrease 1916 to 1917	1916 to 1918	1916 to 1919	1918 to 1919
Garbage Collection													
1 Estimated population	188,000	194,000	200,000	205,000	210,000	215,000	220,000	220,000[7]	237,2376				
2 Number of tons collected	17,534	18,789	20,711	21,629	22,909	21,861	17,127	15,630	18,120	— 22	— 29	— 17	— 16
3 Pounds per capita collected	187	194	207	211	218	203	156	142	153	— 23	— 30	— 28	— 6
4 Total collection cost delivered to loading station					$41,823	$44,842		$54,700	$52,835		+ 22	+ 40	— 15
5 Pe. ton collection cost delivered to loading station					$1 83	$2 05		$3 50	$3 47		+ 70	+ 69	— 1
6 Per capita collection cost delivered to loading station					$0 198	$0 208		$0 265	$0 249		+ 22	+ 23	+ 19
7 Labor cost in collecting and loading						$21,152		$25,786	$30,604		+ 22	+ 45	
8 Stable cost in collecting and loading						$16,434			$27,342			+ 66	
Garbage Disposal													
9 Tons garbage reduced during year	17,534	18,789	20,711	21,629	22,909	21,861	17,127	15,630	18,126	— 22	— 29	— 17	+ 16
10 Tons per day reduced (aver. for 313 days)	56	60	66	69	73	70	55	50	58	— 22	— 29	— 17	+ 16
11 Tons per day reduced (max. month)	.....	.....	.....	.....	106	100	85	63	80	—	— 26	— 20	+ 27
12 Tons per day reduced (min. month)	.....	.....	.....	.....	54	48	39	39	42	—	— 19	— 13	+ 8
13 Tons of grease extracted	391	511	548	593	507	672	388	338	352	— 42	— 50	— 52	+ 4
14 Per cent of grease extracted	2.227	2.721	2.697	2.744	2.214	3.076	2.261	2.164	1.942	— 26	— 30	— 37	— 10
15 Value of grease per 100 lb	$4.39	$4.17	$3.75	$4.325	$3.76	$5.16	$7.50	$11.75	$6.72	+ 45	+ 128	— 30	— 43
16 Total value of grease	$34,325	$42,560	$40,839	$52,672	$38,049	$69,452	$58,398	$79,492	$47,372	— 16	— 14	— 32	— 40
17 Total value of grease	2,344	2,186	2,095	1,753	2,298	2,253	1,754	1,603	1,558	— 22	— 29	— 31	— 3
18 Tons of tankage produced	13 57	11 64	8 10	10 031	10 307	10 214	10 258	8 60		— 1		— 17	— 16
19 Percentage of tankage produced	13 57	11 64	8 10	10 031	10 307	10 214	10 258	8 60		— 1		— 17	— 16
20 Value of tankage per ton	$9 87	$7 532	$6 79	$7 41	$7 00	$7 84	$10 85	$19 80	$15 65	+ 38	+ 153	+ 100	+ 21
21 Total value of tankage	$23,164	$17,529	$14,223	$12,988	$16,082	$17,672	$19,015	$31,708	$24,336	+ 8	+ 79	+ 38	+ 23
22 Total value of production	$58,722	$61,729	$54,800	$66,722	$55,364	$88,564	$79,344	$112,288	$73,248	+ 14	+ 27	— 17	— 35
23 Per ton value of production	$3 35	$3 29	$2 74	$3 085	$2 42	$4 05	$4 62	$7 18	$4 05	+ 14	+ 77	0	— 44
24 Total cost of plant operation (1) (As given by city reports)	$32,482	$38,504	$37,560	$41 86	$40,221	$48,424	$71,911	$85,621	$94,147	+ 48	+ 67	+ 94	+ 10
25 Per ton cost of plant operation (1)	$1 85	$2 05	$1 81	$1 94	$1 94	$2 22	$4 19	$5 47	$5 19	+ 89	+ 146	+ 134	+ 5
26 Production value minus operation cost (total) (21-23[2]	$26,239	$23,225	$17,240	$26,502	$10,911	$40,140	$7,433	$26,667	$20,899 (loss)	— 84	— 134	—	—
27 Production value minus operation cost (per ton) (22-24[2]	$1 50	$1 24	$0 83	$1 226	$0 477	$1 836	$0 433	$1 71	$1 15 (loss)	— 76	— 7	—	—
28 Total freight charge loading sta. to plant	$3,260	$3,500[4]	$3,850[4]	$4,020[4]	$4,250	$4,095	$3,185[4]	$3,545[6]	$4,137	— 13	+ 21	+ 1	+ 17
29 Per ton freight charge, loading sta. to plant	$0 186	$0 186[4]	$0 186[4]	$0 186[4]	$0 186	$0 187	$0 187[4]	$0 227	$0 227	0	+ 21	+ 21	+ 0
30 Total freight charge, loading sta. to plant	$11,844	$13,144	$13,144	$13,144	$13,144	$13,144	$13,144	$13,144	$13,144	0	0	0	0
31 Total charge for plant depreciation (at 5%)	$0 68	$0 70	$0 63	$0 61	$0 57	$0 60	$0 77	$0 84	$0 72	+ 28	+ 40	+ 20	— 14
32 Per ton charge for plant depreciation	$0 00	$0 00	$0 00	$12,291	$12,291	$12,291	$12,291	$12,291	$12,291	0	0	0	0
33 Total charge for city water[3]	$47,586	$55,148	$68,845	$69,076	$74,138	$77,954	$100,431	$114,601	$123,719	+ 29	+ 47	+ 59	+ 8
34 Total cost of garbage disposed (23+27+29+31)	$2 72	$3 09	$3 32	$3 23	$3 56	$5 86	$7 32	$6 82	$6 82	+ 65	+ 105	+ 92	+ 7
35 Per ton cost of garbage disposal	$9,238	$9,753	$9,227	$8,701	$8,175	$7,650	$6,598	$6,072	$7,124	— 7	— 14	— 21	— 8
36 Interest charge at 4% on depreciated plant value	$1,898	$6,581	.....	.....	.....	$2,960	.....	.....	.....	.....	.....	.....	.....
37 Net profit from garb. disp. (21 minus 32 and 34)	$0 11	$0 35	.....	.....	.....	$0 13	.....	.....	.....	.....	.....	.....	.....
38 Per ton profit from garb. disp.	.....	.....	$21,272	$11,655	$26,949	.....	$28,211	$8,911	$56,543	.....	.....	.....	+512
39 Net expense of garb. disp. (32 plus 34 minus 21)	.....	.....	$1 03	$0 54	$1 18	.....	$1 65	$0 57	$3 10	.....	.....	.....	+443
40 Per ton expense of garb. disp	.....	.....	$0 01 (profit)	$0 05	$0 12	$0 01 (profit)	$0 16	$0 04	$0 24	.....	.....	.....	+500
41 Per capita expense of garbage disposal	$0 01 (profit)	$0 034 (profit)	$0 10	$0 12	.....	$22,691	$25,891	$31,601	$37,703	+ 14	+ 39	+ 66	+ 19
42 Labor cost of reduction	$21,681	$24,171	$20,744	$20,222	$7,021	$9,145	$25,027	$21,291	$19,664	+ 174	+ 133	+ 115	+ 8
43 Fuel cost of reduction	$5,965	$7,443	$6,864	$6,777	0 225	0 225	0 373	0 411	0 378	+ 37	+ 42	+ 58	+ 8
44 Fuel consumption per ton of garbage, in tons	.....	.....	0 225	0 225	0 225	0 225	1 134	1 664	1 647	+ 31	+ 31	+ 92	+ 1
45 Gasoline consumption per ton of garbage, in gals	.....	.....	0 874	0 884	1 235	0 866	7 293	9 877	7 715	+ 42	+ 42	+ 92	+ 22
46 Power consumption per ton of garbage, in kw. hours	.....	.....	5 17	4 48	4 321	5 144	.....	.....	.....	+ 89	—	—	—
47 Profit from percolator operation, per ton	No percolator	.....	$0 482	$0 679	.....	$0 78	$1 474	.....	.....	.....	.....	.....	.....

[1] Not including charge for water used from city mains, see item 31. [2] These figures are given in the city reports as profit or loss from the operation. [3] Plant used city water, 1913-1919, metered use in 1919, used as basis for each year's charge. [4] Estimates same per ton as years 1915 and 1916. [5] Estimates same per ton as year 1919. [6] 1920 Census population. [7] Population used in city report.

Based on a city ordinance passed in 1912, the campaign to eliminate private garbage collection was progressing satisfactorily until the courts held the ordinance to be invalid. It is estimated that private collectors now cut in to the extent of from 8 to 10 tons of garbage per day, which is a considerable loss in view of the average daily tonnage of only 58 tons in 1919. The plant was designed with the intention of handling the city's entire garbage production. The eight digestors have a nominal capacity of 10 tons each in 12 hours, or a total of 160 tons in 24 hours. During the maximum year 1915, the average daily tonnage was only 73, while the same for the maximum month was only 106. It is therefore decidedly to the interest of the city to get all of the garbage produced.

The percentage of grease extracted is deduced from the total grease production and the total weight of undrained green garbage as weighed in the tank cars on arrival at the plant. With the introduction of the percolation process in 1912, the recovery of grease rose from 2.227 per cent in 1911 to 2.721 per cent in 1912 and reached a high value in 1916 of 3.076 per cent. There was a sharp drop of 26 per cent from 1916 to 1917, and 30 per cent from 1916 to 1918, but the lowest grease content of record was 1.942 per cent in 1919. A drop in grease content was to be expected in 1917 and 1918, because of the preaching of conservation, but it was naturally supposed that the watchfulness over the garbage pail would be relaxed in 1919.

Prices received for grease fluctuated between $3.75 and $4.39 per 100 lb. from 1911 to 1915. In 1916 there was a sharp rise to $5.16, and in 1917 to $7.50, but in 1918 the unprecedented price of $11.75 was received, an increase of

over 200 per cent above average prices of the pre-war period. The Columbus plant received only $6.72 for grease in 1919 due to a sharp drop in the market, although some other plants managed to sell at a higher figure.

Tankage prices, which fluctuated between $6.79 and $9.87 per ton in the years 1911 to 1916, jumped to $10.85 in 1917, and to $19.80 in 1918, an increase of 153 per cent over the 1916 price. The percentage of decline in 1919 following the armistice was much less than was the case with grease, a price of $15.65 per ton being received.

Items 25 and 26 in Table I give the total and the per ton excess of production revenue over plant operating expense as found in the city reports. It is these figures in the annual reports which are designated as profit from the operation. Each year except 1919 shows an excess of revenue; the largest total—over $40,000, or $1.84 per ton—is shown for 1916. But, as has been stated previously, these figures do not show actual profit.

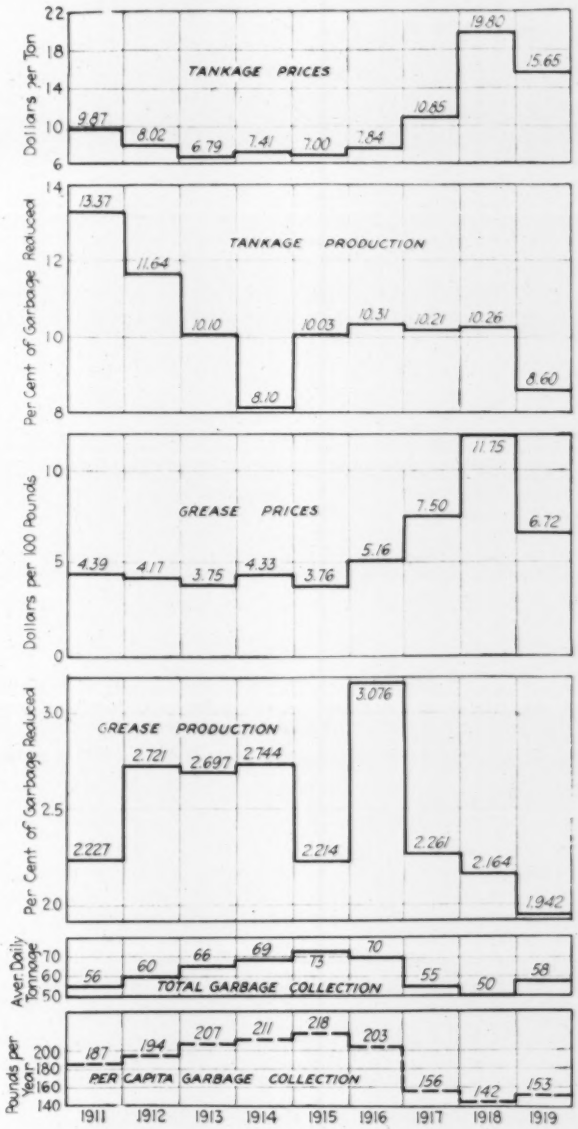
Item 32 gives the total cost of garbage disposal from the time that the garbage is delivered to the city loading station. To the cost of plant operation, as given in the city reports and shown in item 23, is added the freight charge from the loading station to the plant, the charge for plant depreciation, and a charge for city water used. Originally the condenser cooling water was obtained from the river, and subsequently from deep wells, but since 1912 water has been used from the city main which supplies the sewage-works. Until July, 1918, the water used at the garbage plant was not separately metered. The metered usage in 1919 was 15,195,000 cu.ft., which at prevailing rates to consumers was worth $12,291. The reports of the Water Department indicate that this sum is not greatly in excess of the actual cost of supplying the water, which is both softened and filtered. In lieu of meter readings, a uniform charge of $12,291 is made for each of the years 1913 to 1919. This charge is less than that made in 1916 in the report by the New York Bureau of Municipal Research previously referred to.

In order to compare the total expense chargeable to garbage disposal with like figures for other plants an

TABLE II. SUMMARY OF YEARLY OPERATION OF COLUMBUS GARBAGE REDUCTION WORKS, 1911–1919

Year	Tons of Garbage Reduced	Total Cost of Garbage Disposal[1]	Total Value of Product[2]	Profit or Deficit Not Including Interest Charge: Profit	Profit or Deficit Not Including Interest Charge: Deficit	Depreciated Value[3] of Plant	Interest on Depreciated Value, at 4% per Annum
1910						$236,881	
1911	17,534	$47,586	$58,722	$11,136		230,959	$9,238
1912	18,789	55,148	61,729	6,581		243,815	9,753
1913	20,711	68,845	56,800	.....	$12,045	230,671	9,227
1914	21,629	69,676	66,722	.....	2,954	217,527	8,701
1915	22,909	74,138	55,364	.....	18,774	204,383	8,175
1916	21,861	77,954	88,564	10,610	.....	191,239	7,650
1917	17,127	100,431	79,344	.....	21,107	178,095	7,124
1918	15,630	114,601	112,288	.....	2,313	164,951	6,598
1919	18,126	123,719	73,248	.....	50,471	151,807	6,072
Totals	174,316	.....	.....	$28,327	$107,648	...	$72,538
					—28,327		+79,337
Total deficit					$79,337		$151,875
Net cost of disposal per ton					$0 464		$0 878

[1] Includes plant operation, freight charge for city water used and 5% depreciation, but not interest charge. [2] Sale of grease, tankage, hides, etc. [3] Of this deficit for the period, $86,037 is due to city water consumed from 1913 to 1919. [4] Without interest charge. [5] With interest charge.



OPERATING RESULTS OF THE COLUMBUS GARBAGE REDUCTION WORKS, 1911 TO 1919

interest charge of 4 per cent on the depreciated value of the plant (item 34) is added to item 32 and is then balanced against the production revenue to give the net profit or the net cost of garbage disposal to the taxpayers. From an examination of items 35 and 37 it will be seen that in the three years 1911, 1912 and 1916 there was an actual profit over and above all charges, but in the other six years garbage disposal did not pay for itself, the heaviest deficits occurring in 1917 and 1919. These figures are further analyzed on per ton and per capita bases in items 38 and 39.

Cost of Garbage Disposal During Nine Years—In Table II are summarized the tonnage of garbage handled per year, the total cost of garbage disposal and the production revenues for the nine years 1911 to 1919. A total deficit of $79,337 is shown, or $0.46 per ton of garbage handled, without the inclusion of interest charges. This deficit was met by general taxation and does not add to the investment in garbage disposal, so that interest charges in the last column of Table II are

figured on the yearly depreciated plant values, applying a straight 5 per cent yearly depreciation on the total investment. Interest charges add $72,538 to the deficit, giving a total of $151,875, or $0.87 per ton of garbage reduced. Of this total, $86,037 is represented by charges for city water consumed from 1913 to 1919.

The 1919 Operation—In spite of greatly increased labor and fuel costs in 1918, the top prices received for both grease and tankage gave a revenue which nearly offset all charges, including interest. In 1919, while the revenue from grease fell off 40 per cent, and from tankage 23 per cent, the labor cost increased 19 per cent and the fuel cost decreased only 8 per cent. A 10 per cent increase in operating expense was therefore coincident with a 35 per cent drop in production revenue. The grease extraction fell even below 2 per cent to a value of 1.942. Grease percentages in the raw garbage for the two years are not available to afford a comparison of the actual efficiency of the grease extraction in the plant.

TABLE III. AVERAGE ANALYSIS OF COLUMBUS GARBAGE PRODUCTS IN PERCENTAGES

	Tankage					Grease			
Year	Moisture	Ammonia	Potash	B. P. L.	Ether Extract	Moisture	Impurities	Unsaponifiable	Free Fatty Acids
1919									
1918	3 39	3 77	1 08	7 94	.....	1.96	0 55	4 57	
1917	2 76	3 86	1 06	7 56	4 26	1.025	0 732	2 830	27 512
1916	2 85	3 89	1 39	7 99	3 31	1 11	0 46	3 54	
1915	3 37	3 62	1 12	6 83	2 90	1.56	0 196	3 37	.....
1914	3 10	3 58	0 78	8 08	1 20	.....	.....	.....	.....

The 1920 Operation—The plant operator expects a more favorable report at the end of 1920. Grease prices are higher than those received in 1919. At the time of the writer's visit to the plant in June, it was expected that a well water supply would be available for use in a few weeks, which would reduce the water charge and at the same time provide a colder water for summer use.

It should not be assumed, however, that the Columbus plant is unsuccessful because it is not entirely self supporting. The operation in 1919 was a big expense to the taxpayers,it is true, but this was an unusual year. When the 1919 results are averaged with those for the years 1911 to 1918, the net expense of garbage disposal is less than a dollar per ton. This figure does not compare so unfavorably with those for many other cities during the same period. From the viewpoint of service rendered—disposal of the collected garbage quickly and inoffensively—the Columbus method probably surpasses that in certain other cities.

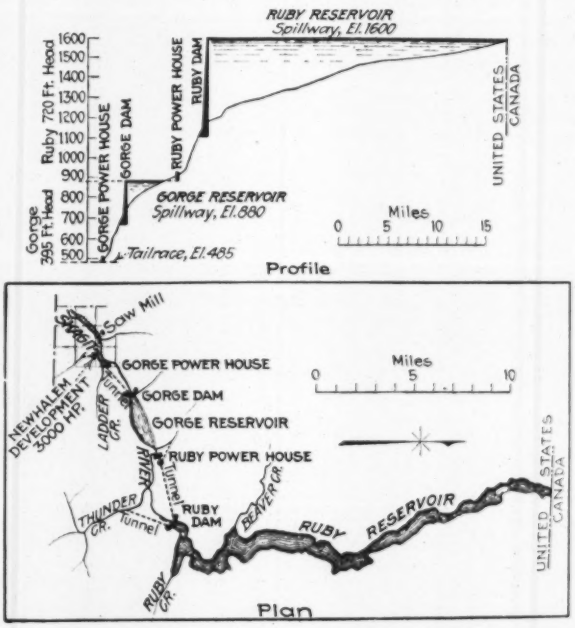
More satisfactory financial results depend in the largest degree upon the income derived from grease. It is hopeless to attempt to prophesy future grease prices, but it is within the power of the city to increase the percentage of grease extraction. Since the time that the local courts decided against the city ordinance which prohibited private collection of garbage, a similar case in Detroit has been carried to the U. S. Supreme Court where a verdict was rendered in favor of the city. This case and others referred to in *Engineering News-Record*, Aug. 12, 1920, p. 314, holds forth hope to the city of Columbus in attempting again to eliminate private collection. The estimated present private collection is probably depriving the city of at least $10,000 in yearly revenue.

Seattle Building Large Municipal Hydro-Electric Development

BY C. F. UHDEN
Chief Engineer, Skagit River Power, Seattle, Wash.

UNDER the supervision of its city engineer, A. H. Dimock, the city of Seattle, Wash., has made a complete study and survey of the power possibilities of its surrounding district and has chosen as the most feasible and profitable the development of the Upper Skagit River where ultimately about 500,000 hp. can be obtained. Work is now under way on the preliminaries of the project.

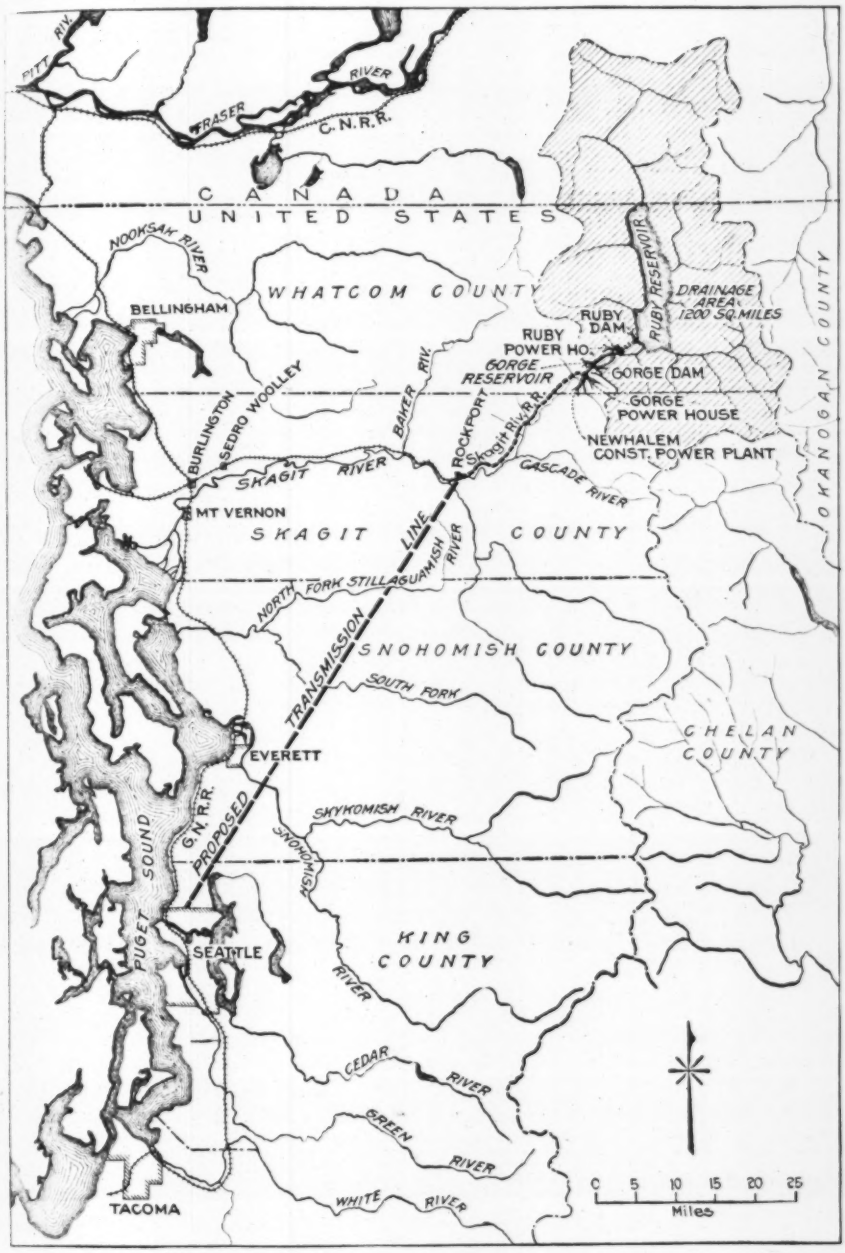
As shown on the map on p. 995 the Skagit River rises in British Columbia, somewhat southerly of a line joining the towns of Hope and Princeton. Flowing first in a general southwesterly and southerly direction, it crosses the international boundary some seventy miles to the eastward of Bellingham, and picks up Ruby Creek at Ruby, some twenty-five miles below the boundary line; continuing southwesterly for another thirty miles,



PLAN AND PROFILE OF SKAGIT PROJECT

it picks up the Cascade River at Marblemount, the Sauk River at Rockport and the Baker River at Concrete, then flows due west for 40 miles to Sedro-Woolley. Ten to fifteen miles southwest Sedro-Woolley empties into puget Sound through the many mouthed Skagit Delta which comprises the eight mile stretch of shore line between LaConner and Milltown. The Skagit River, then, is one hundred and fifty miles long, and drains an area of more than three thousand square miles.

Of this three thousand mile area, the Skagit River project will develop the entire power of the upper third which lies between two mountain ranges of the Cascades. The main range or divide of the Cascade bounds its catchment on the east and the range of which Mt. Baker is the best known peak constitutes its western boundary. The run-off of approximately twelve hundred square miles will be utilized through a total fall of approximately eleven hundred feet.



MAP OF SKAGIT HYDRO-ELECTRIC DEVELOPMENT

The flow of the Upper Skagit River varies from 800 sec.-ft. at low water to about 50,000 sec.-ft. at high water period with an average flow throughout the past ten years of approximately 3,575 sec.-ft. It is the intention ultimately to utilize, as nearly as is practical, the entire flow through the total available head. This will be accomplished by means of two plants, one in the vicinity of Stetattle Creek and one in the vicinity of Ladder Creek, the former having a dam just below the junction of Skagit River and Ruby Creek and the latter having a dam just below the outlet of Gorge Creek.

The waters of Thunder Creek will be utilized by means of a tunnel connecting it with the Ruby Dam and the waters of Stetattle Creek will also be carried in a tunnel terminating at the surge tower above the plant.

Extensive diamond drilling has been carried on at the two dam sites showing solid rock of exceptional quality, known as gneiss, at a maximum depth of 110 ft. at the Gorge Dam site and at a maximum depth of 30 ft. at the Ruby Dam site. These drillings show only a moderate amount of excavation as the channel in both cases is narrow and has rocky cliffs on both sides extending several hundred feet above the present water surface.

The Ruby plant, constituting the upper development, will consist of a dam approximately 450 ft. in height, a tunnel 17,000 ft. in length of about 600 sq.ft. section and an ultimate installation of six 45,000 kva. units operating under a head varying from 720 ft. to 470 ft.

The available capacity of the Ruby Reservoir, whose surface elevation will be 1,600 ft. above sea level when full, will be approximately 1,000,000 acre feet and will at times be drawn down to an elevation of 1,350, a difference of 250 ft. causing the variation in head at the Ruby plant above referred to.

The ultimate development of the Gorge plant will consist of a dam 240 ft. in height, two tunnels 11,000 ft. in length of 300 sq.ft. area and six 30,000 kva. units operating under a head of 395 ft.

Not having any available power for construction purposes within a reasonable distance of this development it was decided to put in 3,000 hp. hydro-electric plant on Newhalen Creek. This stream has a maximum flow of about 500 sec.-ft. and a minimum flow of 40 sec.-ft. This will consist of a small crib dam, 2,720 ft. of 5 x 7 ft. tunnel, 700 ft. of steel penstock and a 3,000 hp. Pelton impulse wheel, direct connected to a 2,500 kva. Westinghouse 6,600 volt generator, and will operate under a head of 500 ft.

Rockport, located on a branch of the Great Northern, is the nearest railroad point and is 23 miles distant from the Gorge power house. On account of the large tonnage that will be handled, it was decided to build a railroad from Rockport. This railroad is now under construction and will in all probability be completed to the Gorge plant by March, 1921. At present all supplies and material are being transported by three 10-ton Holt caterpillars and six 5-ton Troy trailers.

The tunnel for the Newhalen plant is now being

driven and it is hoped to have the plant in operation by next April. A saw mill of 25,000 board feet capacity has been put in operation, which supplies lumber for the temporary camp. This camp will consist of some 75 three-room cottages to be used by the married men, 6 bunk houses of 12 rooms each, capable of housing 24 men each. Bath houses, commissary, warehouse, hospital, mess house, etc., are also provided.

The energy will be conveyed over a transmission line of about 100 miles in length, having wooden pole structures and a pressure of 154,000 volts. The survey not being completed this line is shown on the map as a straight line and indicates the general location.

It is hoped that energy from the Gorge plant, which is the first to be developed, can be utilized by the city of Seattle some time during the year 1923.

Improve Old Freight Yard for Better Operation

Gravity and Flat Switching Combined in New Facilities for Heavy Traffic—Changes in Hump Profile—Seven Converging Lines Complicate Division Point Problem

INCREASED rapidity, economy and convenience in yard operation to meet conditions of greatly increased traffic are the results sought by the Chicago, Burlington & Quincy R.R. in undertaking the enlargement and improvement of its freight yard at Lincoln, Neb., which is an important division point. This work is an example of improvements that must be carried out at many existing terminals to make their facilities adequate for present conditions of traffic and the economical operation. In this respect the work at Lincoln differs from that of the division yards of the Michigan Central R.R. at Niles, Mich., and the Denver & Rio Grande R.R. at Soldier Summit, Utah, which were described in *Engineering News-Record*, Jan. 8 and May 27, 1920, pp. 81 and 1069, respectively. At the latter points entirely new yards of modern design have been built on a new site, unhampered by existing facilities.

Operating Methods—A combination of gravity and flat switching is a feature in the operation of the Lincoln yard, the layout of which is shown in Fig. 1. This combination method was introduced under an emergency and was not included in the original plan, but it is continued in the reconstructed yard as it is found to suit local conditions. The improvements now being made, which are based upon a modification of the original design, provide for handling the westbound business by flat switching and the eastbound business (when classification is required) by hump or gravity switching. Such a combination is unusual, but is employed also in the company's larger yard at Galesburg, Ill., where the two methods are used for handling different commodities.

The heaviest loaded movement at the Lincoln yard is eastbound and consists largely of grain, coal, stock and lumber. Stock is handled mainly in solid through trains and these are passed around the switching hump as they are not broken up for classification and are stopped only for inspection and to change engines. The westbound movement consists mainly of l.c.l. merchandise, stock and empty stock cars. All this traffic has a seasonal variation.

An explanation of the history and operating conditions is necessary for an understanding of the reconstruction work. In 1907 plans were made for a very comprehensive layout, consisting of two separate units for eastbound and westbound traffic, both arranged with gravity switching for the classification service. Each unit was to consist of a receiving yard, switching hump, classification yard and departure yard, with a storage yard serving both units. Both switching humps were graded, but in 1907, before the tracklaying was completed, a period of depression had begun and it was necessary to discontinue the work and adapt the existing trackage to handle all business. This trackage consisted mainly of the eastbound unit (as above) and the first part of the receiving yard for the westbound unit.

To utilize the existing layout for the classification of traffic in both directions necessitated introducing reverse movements for all westbound traffic. Thus, a westbound train had to travel the entire length of the site to enter the eastbound receiving yard at the west end of the site, its cars being then moved eastward over the hump to the classification yard and eastward again to be made up into trains in the departure yard at the east end of the site. From this yard the westbound trains again traveled the entire length of the site before pulling out on the main line.

Eastbound movements were made logically in sequence from the main line to the receiving yard, the switching hump, classification yard and departure yard, from which last the trains proceeded east onto the main line. Trains in either direction which did not require classification, or complete cuts of cars ready to be attached directly to outbound trains waiting for them, were passed around the hump.

Until the war, the business had not grown sufficiently

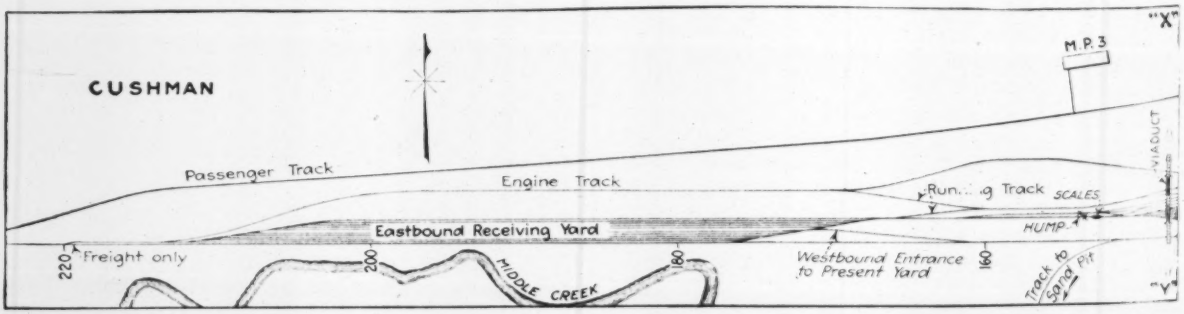


FIG. 1. NEW LAYOUT OF FREIGHT YARD AT LINCOLN.

to warrant completing the yard according to the original design, but under changed conditions and with heavy business better facilities have become highly desirable to provide for prompt movement and the reduction of delays. Owing to the smaller proportion of cuts in westbound traffic, the original design was modified, the second hump being omitted and flat switching substituted for westbound movements. It is considered that under the conditions of traffic at this point the yard operation can be handled more quickly and economically by this combination of methods.

TABLE I. FREIGHT YARD BUSINESS AT LINCOLN, NEB., C. B. & Q. R.R., (SEPT. 2, 1919)

Inbound	South and East	North and West	Total
No. of trains	15	10	25
Trains put over the hump	10	7	17
No. of cars	745	612	1,357
No. of cars weighed	49	65	114
No. of cuts	321	309	630
No. of through cars	528	303	831
No. of cuts of through cars	268	170	438
No. of local cars (empty stock)	309	20	331
No. of cuts of local cars (empty stock)			65
Total local cars	416	103	531
No. of cars marked bad order			63
No. of destinations of through cars	9	15	24
Outbound			
No. of trains	13	14	27
No. of cars	670	836	1,506
Cars taken from repair track			71
No. of destinations	7	3	10
Cars per train, average	40 to 60	40 to 70	...
Cars per train, maximum	81	84	...
Cars per train, minimum	9	17	...

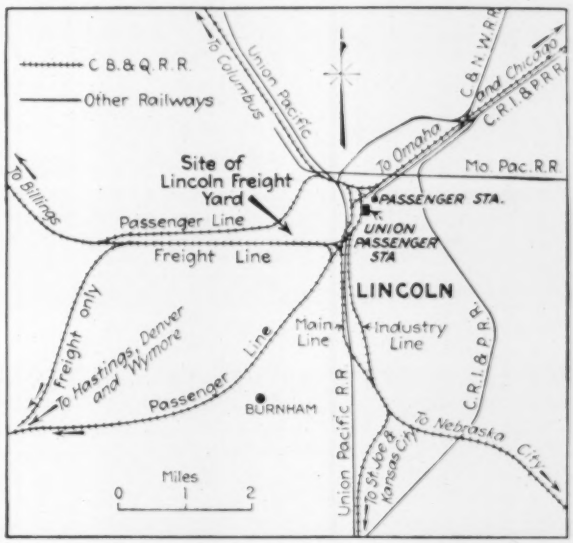


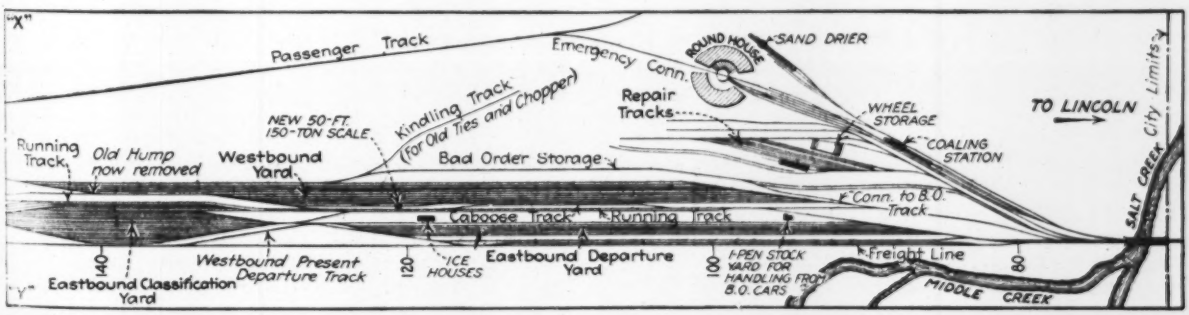
FIG. 2. RAILWAYS CENTERING AT LINCOLN, NEB.

New Yard Plan—The layout of the yard as it will be when the present alterations are completed is shown in Fig. 1. Reverse movements will be eliminated, but all westbound switching movements will be handled by drill engines in one large flat yard which will comprise receiving, classification and departure tracks. The drill engines will work at both ends of this yard. To permit of the necessary extensions, the old unused hump for westbound traffic has been removed, the material being utilized for grading the additional space for the flat yard.

Eastbound freight trains will pull out from the main track onto a lead track about 800 ft. long, connecting with the ladder of the receiving yard. This yard has 10 tracks about 3,600 ft. long, with a total capacity of 760 cars. Here the engines and cabooses will be cut off and moved over a thoroughfare or running track to the engine terminal and caboose track at the east end of the site. Yard engines will push the trains up to the hump, the cars moving thence by gravity to the classification yard, which has 20 tracks, varying in length from 800 to 2,100 ft., in addition to a central track for the locomotive which carries the car riders back to the hump. Yard engines will then take the cars to make up trains in the departure yard, which has ten tracks about 3,600 ft. long. Solid eastbound through trains and cuts which are to be made up into trains will be moved directly from the receiving to the departure yard over a run-around track. Cars held for orders, or "hold" cars, will be accommodated on six tracks in the old westbound receiving yard.

The flat yard for westbound trains has twelve tracks, seven of these being about 3,600 ft. and the others 4,500 ft. long. Trains will enter the shorter side, departure trains being made up on the longer side of the yard, the tracks on that side being used for classification or storage as may be necessary. Road engines will take their trains out over a running track north of the eastbound receiving yard.

Switching operations at Lincoln are complicated by the fact that seven lines of three divisions of the Chicago, Burlington & Quincy R.R. meet at this point, as shown by Fig. 2. There are four main lines from Omaha, Kansas City, Denver and Billings, Mont., and three local lines from Columbus, Nebraska City and Wymore, Neb. Under this condition there is an unusual amount of switching and classification for destinations. Four other railways pass through Lincoln and involve a certain amount of interchange or transfer movement. The yard operating conditions are illustrated by Table I, which gives the record for the 24-hour period of Sept. 2, 1919.



NEBRASKA: CHICAGO, BURLINGTON & QUINCY RR

TABLE II. CHANGES IN PROFILE OF SWITCHING HUMP AT LINCOLN, NEB.; C., B. & Q. R.R.

	Proposed for Westbound Hump	Eastbound, Hump — Present	1914	As Built	Original Design
Approach	2.67% for 60 ft.	2.67% for 60 ft.	1.64% for 100 ft.	1.6 and 2% for 74 ft.	1.0% for 207
Summit	0.33% for 50 ft.	0.33% for 30 ft.	0.44% for 25 ft.	0.4% up for 25 ft.	Level for 10
Starting grade	2.0 % for 125 ft.	2.0% for 20 ft.	0.36% for 25 ft.	2 % for 25 ft.	1.0% for 25
Starting grade		3.84% for 60 ft.		3.6% for 25 ft.	
Starting grade		2.0% for 20 ft.	3.16% for 50 ft.	2.8% for 25 ft.	
To scale		1.6% for 25 ft.	0.8% for 12 ft.	1.5% for 20 ft.	2.0% for 14
On scale	1.0 % for 50 ft.	0.8% for 50 ft.	0.9% for 35 ft.	1.2% for 50 ft.	2.0% for 50
On scale			1.3% for 15 ft.		
Off scale	2.0 % for 20 ft.	2.0% for 26 ft.	0.9% for 12 ft.		2.0% for 8
Accelerating	4.0 % for 75 ft.	5.0% for 20 ft.	3.12% for 25 ft.	2.4% for 25 ft.	3.0% for 28
Accelerating		1.35% for 15 ft.	3.64% for 50 ft.	2.8% for 25 ft.	
Accelerating	2.9 % for 110 ft.	5.0% for 26 ft.	3.46% for 50 ft.	3.2% for 25 ft.	3.5% for 150
Accelerating		2.92% for 130 ft.	2.84% for 50 ft.	2.8% for 100 ft.	
Through ladder	1.2 % for 142 ft.	1.2% for 142 ft.	2.26% for 50 ft.	2.2% for 50 ft.	
Through ladder	0.51% for 118 ft.	0.51 % for 118 ft.	1 and 0.8% for 250 ft.	1 and 0.8% for 250 ft.	0.8% for 318 ft

Hump Profiles—The profile of the switching hump has been changed from time to time to meet actual requirements of operation, as shown in Fig. 3 and by Table II. In this respect it resembles many other existing hump profiles. An unusual and rather unfavorable feature is the short distance from the scale to the first switches of the classification yard, this distance being only about 75 ft. The first change was to give a higher summit with starting grades of 2 and 3.5 per cent, reduced to 1 per cent over the scale and then increased to 2.8 and 3.2 per cent to the ladder. In 1914 the hump was raised again to give steeper grades, with 3.36 and 3.16 per cent above the scale and 3 to 3.64 per cent below it. A profile suggested at that time for the westbound hump called for a 2 per cent starting grade. 1 per cent over the scale and 4 per cent to the ladder.

In 1917 the summit was raised to a still higher elevation and shifted farther back in order to increase the length of the starting grade. At present this grade is 3.6 per cent, followed by 1 per cent over the scale, and then by an accelerating grade of 3.6 to 2.8 per cent to the ladder, along which the grade is carried at 0.8 to 1 per cent. This present profile will be continued, as it is found to be satisfactory in both hot and cold weather. The steep grades of the hump are connected by vertical curves of the cubic parabola type laid out approximately in accordance with the Henck method.

Tracks and Lighting—The yard is laid with 85-lb. rails for the leads and running tracks and 75-lb. rail for the body tracks. The sharpest curves are of 7½ deg. Turnouts have No. 9 frogs and 15-ft. switch rails. Ladders are 1 in 7, or at an angle of 8 deg. 10 min. with the body tracks. The classification yard has No. 7 frogs on a ladder of 6 deg. 20 min. Hand operation of switches is employed for the classification movements, about four switchmen and twelve car riders being required during the busy hours. The car riders are returned to the hump by a yard engine which runs back and forth on the middle track of the classification yard. Flood lighting is used for the hump and the classification and flat yards, the lamps being on 20-ft. poles placed along both ladders and along the running tracks.

The yard has a single track connection at each end and its total length is about three miles between end switches. An unusual feature of the layout is that no passenger tracks are required, the site being located between two converging lines. A single main track along the south side provides for through freight movements. The ground is level at the east end of the side and then rises at a flat slope of 0.1 to 0.2 per cent towards the west.

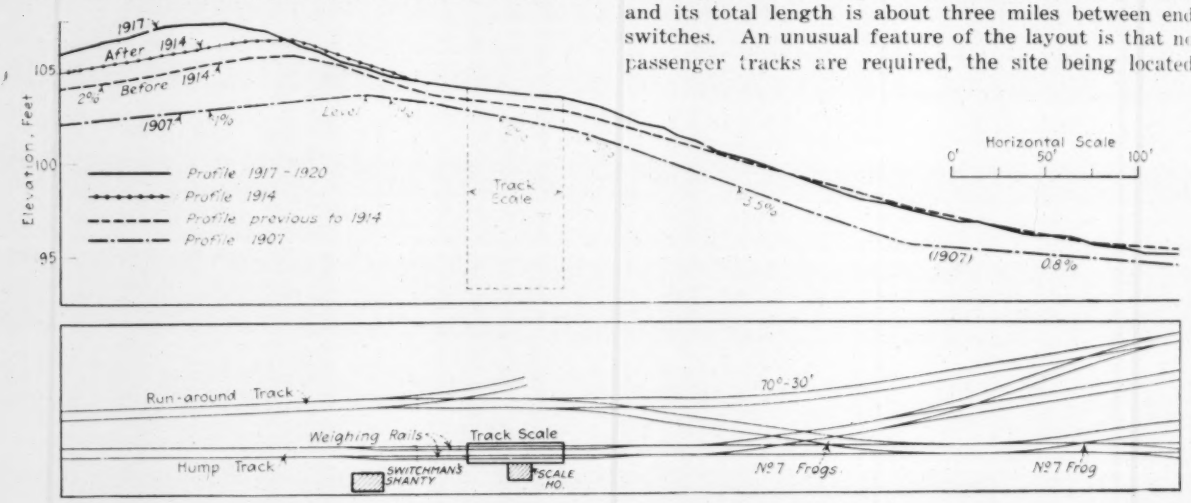


FIG. 3. SUCCESSIVE PROFILES OF SWITCHING HUMP

As the site is on marshy ground and the subsoil is an impervious clay, special means are provided for drainage of the yard. An earth fill brings the subgrade level about 8 ft. above that of the natural ground, and in the top of this fill are formed transverse French drains. These are trenches about 4 ft. wide and 4 ft. deep, filled with broken stone, brick and loose rock and covered with sand. Over the entire surface of the fill is a bed of clean sand about 12 in. deep, so that water will pass freely through this bed to the drains. Cinder ballast about 12 in. deep is laid upon the sand, and in this the ties are embedded.

Engine Terminal—Locomotives and cabooses are changed on all trains, as Lincoln is a division point. Engine terminal facilities and a car repair yard are provided at the east end of the layout, incoming engines

in the westbound yard being shifted onto a running track and moved back to the yard entrance, where the switch connection to the engine terminal is located. Incoming engines of eastbound trains are run to the east end of the yard for the same purpose. Caboose cars from trains in both directions are placed upon a track near the east end, from which they can be switched conveniently to both departure yards.

An ice house is provided for serving refrigerator cars in both directions. Owing to the large amount of stock traffic a stock pen is provided for stock unloaded temporarily from a bad-order car. A long storage track can hold 70 bad order cars waiting to be sent to the repair yard. All departure tracks are equipped with compressed air for testing the train brakes before the road engines are attached. Track scales are provided on the switching hump and on a weighing track near the west end of the flat yard. Each is of 150 ton capacity, with a table 50 ft. long.

The revised layout of the Lincoln yard, with the improvements now being carried out, was planned under the direction of A. W. Newton, chief engineer, and F. T. Darrow, assistant chief engineer of the Chicago, Burlington & Quincy R.R.

Intermittent Reduced Lime Feed

THE filter plant at Grand Rapids, Mich., is still being operated on the intermittent plan of reduced lime feed, as described by Walter A. Sperry, chief chemist, in *Engineering News-Record*, Nov. 27-Dec. 4, p. 923. In his annual report for fiscal year ended Mar. 31, 1920 (not printed), he states that the standard of hardness maintained has been that of Lake Michigan, 7.5 to 8 gr. per gallon. The standard is reasonably acceptable to the users and the intermittent plan continues to act more effectively in reducing after deposits than any other method tried. Never before has the small scale in the water cylinders of the high service pumps been so thin or scant. This year it was possible for the first time to omit the usual cleaning and overhauling of the sand beds. The filters were free from the usual mud deposits, the gravel was found unpiled and the sides free from caked masses of sand and sludge. Finally there have been no complaints because of deposits in heaters and furnace coils.

On the black portion of the accompanying chart is shown the amount of hardness removed, an average of 6.3 gr. per gallon or 5.94 tons of lime rock per day from the average consumption, 13,200,000 gal. The portion above the curve of incrusting hardness, an average of 3.2 gr. per gallon, is carbonate hardness. In the filtered water the latter averages 4.6 gr. per gallon. The average total hardness of the river was 14.1 gr. per gallon and of the filtered water 7.8 gr. per gallon.

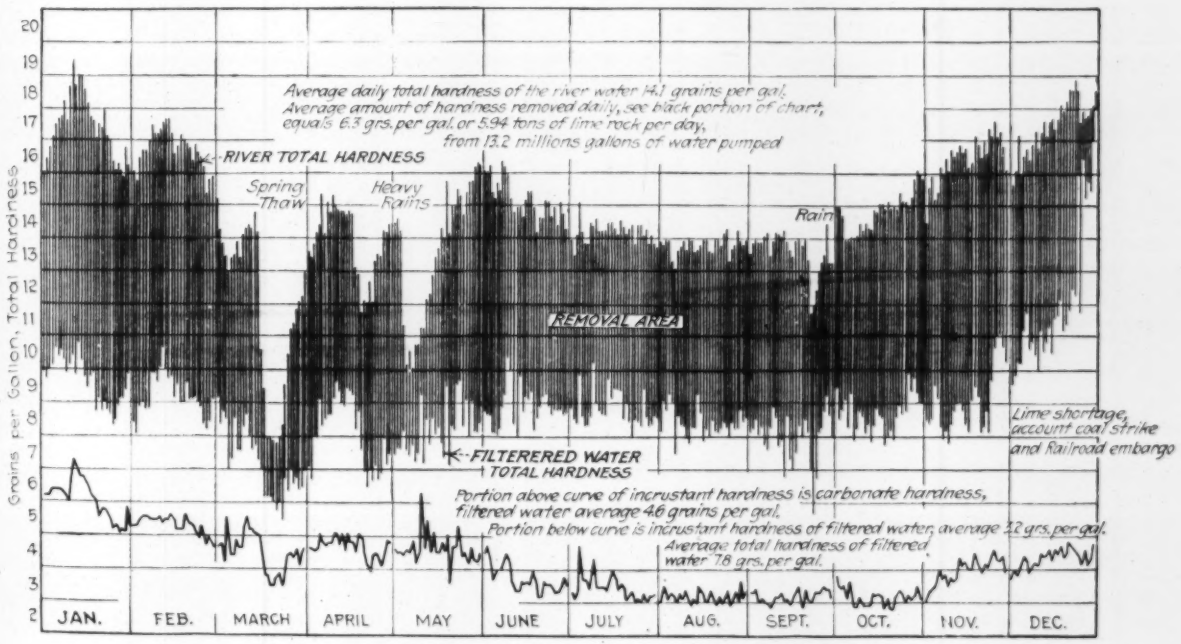


Chart showing Daily Total Hardness of River and Filtered Water 1919

HARDNESS REMOVAL RESULTS AT GRAND RAPIDS PURIFICATION PLANT, 1919

Sells Water at 2½ Cents Per Ton

WATER is the cheapest commodity the public buys today, according to the latest annual report of George N. Schoonmaker, assistant commissioner of water, Toledo, Ohio, in a plea for increased rates. Under the present domestic rate water if sold by weight would cost 2½c. per ton. Receipts over expenses in 1918 increased 5.25 per cent but expenditures increased 15.95 per cent. Per capita the consumption was 107 gallons. D. H. Goodwillie, director of public service, summed up the financial solution thus: "While the Division of Water has been able to meet its operating expenses, interest on bonds, retire bonds and invest nearly $500,000 of earnings in extensions and improvements and at the same time close its business with a reasonable balance, the anticipated cost of operation and the unusual demand for water pipe extensions all combine to make necessary an increase in the revenue or a curtailment of its activities."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

British and American Technical Books

Sir—I was much interested in R. Fleming's review in your issue of Sept. 16, p. 568, of a British textbook on "Structural Steel Work." Although I do not intend to pose as the "competent engineer whose appraisal of the relative merits of literature on British and American practice would be welcome," I am tempted to venture a few remarks based on an experience which covers both sides of the Atlantic. Having been for many years designing engineer of the largest bridge company in Canada, and intimately connected with the office, shop and field work of many large structures, including the greatest bridge on this continent, I believe I may claim a reasonable acquaintance with American practice, past and present.

I have not seen the book referred to by the reviewer, but I can readily understand that it would strike him as very different from the majority of the American books, whether of the older types, such as Green, Dubois, Burr and Falk, or of the more modern, as Merriman and Jacoby, Johnson, Bryan and Turneaure, or Molitor. British books on bridges and structural work are few in number, and, excepting perhaps Claxton Fidler's, are quite recent. Books are not used to anything like the same extent in the universities and technical schools of Great Britain or in the office of consulting and manufacturing engineers, as here. Very much more importance is attached to experience, both the experience of men and the experience with structures. Furthermore, bridge and structural work does not, or did not until very recently, constitute a specialized branch of engineering over there as it does here. A great deal could be said upon the advantages and disadvantages of extreme specialization, but this is not the occasion for saying it. The fact remains, however, that a very considerable portion of the leading engineers of Great Britain are not specialists in one line but are engineers generally, grounded in broad principles, trained in various directions, and actually carrying out engineering works of many descriptions. For these and similar reasons, a literature on bridge and structural work is not really existent. The best American books are usually recommended for students in colleges who wish to study texts, and the writer well remembers enjoying one of the early editions of Merriman and Jacoby whilst an undergraduate.

The few books that do refer to actual designs simply state what is the practice of certain shops, and seldom, if ever, attempt to "figure" a bridge or compile a stress sheet. In fact, it is very doubtful if stress sheets are made for the majority of structures, and it is generally understood that none can be found even for the Forth Bridge. The same profound faith in "figures" and "figurability" that characterizes, standardizes, and unfortunately cramps the designing of bridges on this side, does not so entirely govern over there. On the other hand, it is true that many of their structures, if figured according to our methods, show strange results. Particularly is this the case in riveted connections, such as those between the flange angles and web plates on shallow floor beams.

The published papers describing bridges built to purely British or European practice, do not, as a rule, indicate the details of connections. For example, in the case of a very important and really huge undertaking, the Hardinge Bridge over the Ganges (*Proc.* Inst. C. E., vol. 205, 1920), there is characteristically little information given on the steel work of the fifteen 350-ft. double-track spans, approach girders, or erection trusses. In structural work, as in the other branches of the great engineering trades, a great deal of importance is placed upon workmanship. "The little things" are given attention and are looked upon as being essential parts in the "harmonious whole." There is a disposition to treat a bridge as a unit, and not so much as a conglomeration of units—stringers, floor beams, laterals, web members, chords, and so on, each with distinct duties. These items are regarded as working together, mutually helping, rather than as each item unloading its responsibility on to the next until finally the bridge unloads altogether on to the substructure. The short stringers, shallow floor beams, wide truss members, etc., of the British designs, seem to the writer to be conceived in this spirit of participation, whereas our practice very definitely forbids a stringer to help the bottom chords, for instance, or the truss verticals to help the floor beams.

This is a personal view, of course, and may not appeal to all or even many engineers on this side—and indeed might not be acknowledged by many on the other—but from such considerations I would suppose that Mr. Fleming is quite right in saying that to an American engineer the book reviewed is of little value for practical guidance. At the same time, it must be remembered that labor conditions govern the practice more than any other single item. The bending of angles, for example, is done in Europe because there has been a sufficient supply of capable angle smiths. There is no structural argument against bent angles. As connections and stiffeners they would be often convenient and are certainly efficient.

The writer is at present engaged in investigation work where English deck plate girders, built sixty or more years ago, are found in excellent condition and alignment today. These have the regular bent angle or bent tee stiffeners of the British practice, using small flange angles, about 4 x 4 in. and 24-in. cover plates. Incidentally, the metal is without exception much better preserved and much freer from corrosion than American steel of ten or twenty years' life in similar service.

The quoted comments of the technical press are no serious guide to the intrinsic worth of this or any other book. A review like Mr. Fleming's is really of more value, although in this case taken from a viewpoint not, I suppose, even dreamed of by the authors of the book or press comments. The publication evidently was not intended to satisfy the wants or describe

the practice of engineers on this side, and apparently does not do so. Personally, I do not know any British book that does, or that mentions in more than a casual way the distinctive features of American practice. This same American practice is changing with the years and with conditions, and is not drawing further away from, but nearer to, the British and European. Witness the abandoning of pin bridges in favor of riveted joints, the use of continuous spans and even of continuous transverse frames composed of floor beams and truss verticals. "Minutiæ to the *n*th degree" is a rather vague expression, and it is not evident to what particular point the reviewer addresses this phrase.

Regarding stress sheet calculations, the boot is surely on the other leg. It is in America that the German thirst for "all kinds and conditions" of stresses has been cultivated. It is in America where such an unnecessary amount of detail is crammed into all specifications.

Regarding failures of steel buildings, there are very few anywhere, and I believe that actually there may be fewer in Britain than on this side, and for such reasons as the following of safe precedent, the building for admittedly longer life, and the more rigid inspection of workmanship.

"Why are British engineers, writers and manufacturers so slow to adopt things American?" Here is the kernel in the nut. The answer lies perhaps in two words, conditions, convictions. Things American do not always suit conditions outside the United States and it is not everybody who can be convinced of the essential superiority of things American. He would be a "bold, bad Britisher" who undertook to discuss at length such questions in an American magazine today, for many things have happened these last few years, and are still happening, to affect conditions and convictions on both sides of the water.

P. L. PRATLEY,
Late Designing Engineer, Dominion Bridge Co.; now Engineer of Bridges, Grand Trunk Arbitration, Department Railways & Canals.
Montreal, Sept. 25.

"Earthwork and Its Cost"

Sir—Technical book reviews usually belong to one or more of three classes: (1) Those that tell what the book contains; (2) those that tell what the book should have contained; (3) those that are essays suggested by the book. Mr. Hammond's review of the second edition of my "Earthwork and Its Cost" (*Engineering News-Record*, Sept. 16, p. 567), falls mainly unler the second and third classes of reviews, for a reader would gain, from the review, little or no more knowledge of the contents of the book than could be had by reading the title. In fact, the reader would probably be misled by the reviewer into thinking that the book is primarily one on costs, whereas 85 per cent of its 1,346 pages relate to methods, machines, etc., and not to costs. This misleading feature of the review may be attributed to the reviewer's belief that the primary function of a reviewer is to write an essay. Had his essay been entitled "The Futility of Published Cost Data on Earthwork" it would have at least had the merit of not misleading the reader; and at the same time it would have made it more likely to start a general debate.

An author seldom feels like defending his own book, although he does not hesitate to defend a principle from attack. I should be glad to debate the question of the uselessness of published cost data, but I do not care to do so in a letter of this sort. If "Earthwork and Its Cost" is so utterly useless as Mr. Hammond pictures it to be on matters pertaining to cost, then all I can say is that the guilt is not mine, but that of the entire civil engineering profession; for two of my assistants spent two years searching the technical literature and abstracting all that seemed worth-while on earthwork and its cost. The matter thus abstracted would have made three books of the present size of "Earthwork." Probably errors of judgment were made in boiling it down to 1,346 pages, but I feel confident that the writing of very few engineering monographs has involved as much search for information as this writing has involved. This statement will also serve to answer Mr. Hammond's remark that "The next most serious fault is the too great dependence upon Mr. Gillette's own paper, *Engineering and Contracting*. A page count would perhaps reveal far more than half the book is quotations and extracts from that journal." This "fault" is assignable to the fact that, for sixteen years *Engineering and Contracting* has been so edited as to miss very little new and valuable information on excavation.

Mr. Hammond shows a rather surprising lack of knowledge of what is to be found in the private records of contractors when he imputes the alleged deficiency of published cost data to the reluctance of contractors to put their data in the hands of incompetent contractors and engineers. "Costs, in the hands of such," says Mr. Hammond, are useless as Granville's 'Calculus' is to a Hottentot."

Very few contractors have any cost data so analyzed that they will be of use. Fewer still have any such fear as Mr. Hammond imagines them to have. I shall be the last to claim that published cost data are completely satisfactory, but why should published cost data be singled out from all engineering data as a special object of ridicule? Are costs the only things that lack completeness? Listen to what Prof. J. W. Richards (professor of metallurgy at Lehigh) recently said:

> The engineer is confronted with a woeful lack of data on specific heat of substances at moderate and high temperatures, also of specific heats of liquids and gases. It would be making a liberal statement to say that the tables contain 10 per cent of the accurate information in this line which engineers and technologists could use. . . . "The writer is convinced, perhaps because of his greater activity in this field, that data of the class (1) [physical and chemical], are woefully deficient and fragmentary. The best compendium of such information is in the revised Landolt and Bornstein 'Physikalische and Chemische Tabellen,' revised up to 1912. This has been supplemented by the 'Tables Annuelles des Constantes Physiques et Chimiques,' of which three volumes have appeared to date and the fourth is in preparation. These, and similar books and tables, are collections of the most reliable data accumulated in the last century or more by industrious scientific men. The data are of all degrees of reliability and of all degrees of incompleteness in any particular line. The quickest way to get an idea of the state of matters is by discussing a few concrete examples."

Yet, does Prof. Richards rail at the books that contain the available compilations, or at their authors for not entirely recasting the matter that they have abstracted, or at the futility of attempting to enlarge the existing fund of data until some supposedly wise men condescend to make public their wisdom? Prof. Rich-

ards, in strong contrast to Mr. Hammond, does no such thing; but he urges scientific men to gather more data and to publish them for the public benefit.

There are a few minor parts of Mr. Hammond's "review" that might merit discussion, were not the whole of it less a review than an attempt to make the reviewer's opinions appear more important than the author's collection of facts. HALBERT P. GILLETTE.

Chicago, Nov. 1.

Ketchum's Highway Bridges Revised

THE DESIGN OF HIGHWAY BRIDGES OF STEEL, TIMBER AND CONCRETE: By Milo S. Ketchum, C.E., M. Am. Soc. C. E., Professor-in-Charge of Civil Engineering, University of Pennsylvania, etc. Second Edition Rewritten. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co. Flexible: 6 x 9 in.; pp. 550; illustrated. $6.

REVIEWED BY WALTER R. MARDEN

Vice-President and Chief Engineer the United Construction Co., Albany, N. Y.

It is frequently the case that the second edition of a technical book is more useful than the first, and the volume under consideration exemplifies this in a marked degree. In the twelve years since the first edition was issued the current practice of highway bridge designing has improved more than in any similar period of its history. The conditions generally governing the designing of and awarding contracts for highway bridges have frequently been such as to offer a premium on light designs with insufficient and often very faulty details; and this edition of Prof. Ketchum's book should be of interest to every highway bridge engineer as one of the first concrete evidences that these conditions are being overcome. [The first edition was reviewed in *Engineering Record*, Feb. 6, 1909, p. 167, and in *Engineering News*, Feb. 18, 1909, on p. 13, "Engineering Literature Supplement."]

The makeup of a book is usually considered last, if at all, by a reviewer, but whatever the inner qualifications that recommend our friends to us, we first recognize them by external characteristics and first impressions are sometimes as cogent with book users as they are in social amenities. The present volume is as much of an improvement over the first edition in respect to makeup as it is in the treatment of the topics presented.

The introduction of much new material made it necessary to rewrite and rearrange the chapters and divisions, correspondingly modifying the sequence of treatment in many cases, but the total number of pages and approximate size of the first edition have been maintained by the use of smaller type and narrower margins throughout the book. The more important additions are the general specifications for concrete highway bridges and foundations and the examples of standard designs for steel and concrete bridges prepared by the highway departments of several states; but the latter for some reason are limited to Iowa, Illinois and Wisconsin. It would seem to the writer that the homogeniety of treatment, the value of the book for reference and as an exponent of the advance in highway bridge designing mentioned at the beginning of this review would have been enhanced by the omission of the chapter on railway bridge trusses and the inclusion of examples of the standard steel bridge designs of more of the state highway departments—New York and Pennsylvania, for instance. Some of the types of pony trusses shown were practically obsolete in 1908 and are now twelve years more so. Examples of these are the pony Warren and Pratt trusses with top chords formed of two angles separated by the thickness of the gusset plates, shown on pp. 177 and 178; also those shown on pp. 188 and 189. The same might be said of the chord sections of three plates and two angles shown in Table 16, p. 508, the use of which now is faulty designing. This is the type of top chord and end post section almost always used in the earlier examples of double and multiple intersection through lattice trusses, and the writer has found it necessary to reinforce many of them now in use by adding angles to the lower edges of the vertical plates, which usually crumple up under overloads unless they were originally stayed by lattice bars.

About the only thing in connection with highway bridges that persists in perpetual and pristine vigor, never becoming obsolete, is the practice of finding a new name for some slight modification of any type of truss. Our author, to say the least, has not made any effort to better this condition. There seems to be no good reason why a pony Pratt truss should not remain such whether it rests upon a substructure of steel or concrete. On account of the lack of stone and timber in some localities, steel posts with steel plate backing have been used as a foundation for small spans. In the New England States, timber was generally used in the same way, when old railroad rails were not available. By strict analogy to the former case we should then have a "leg bridge" with a wooden leg. To carry this a little farther, why should a through Pratt truss, because it is so long that a curved top chord is economical, become a "camel"; and if such an appellation is proper why should not a Pratt truss deep enough to have overhead bracing become transformed from pony to a "horse"? An example of this tendency is shown on p. 189 where the pony Pratt truss becomes "fish-bellied" because the designer found it convenient to raise the shoes enough to bring the bridge seat to the level of the joists. Considering the particular bridge illustrated here one is tempted to ask whether the name is in deference to the whale or Jonah.

The chapter on timber bridges and trestles contains data enough to give the young engineer some idea of what can be done with this material, and also gives some interesting examples of the work of the highway departments in the western states. The reviewer is reminded that the first time he was called upon to design a timber bridge there was nothing at hand from which any precedent could be gleaned; and it happened to be a design wanted for the same man whose name appears on the cut on p. 262, O. E. Peppard, Missoula, Mont. This lack resulted later in the preparation by the reviewer of a series of standard plans for spans up to 150 or 175 ft. long so that when Mr. Peppard wired for fittings for a span, bills could go to the shop as soon as blueprints could be made and dried.

Chapters 24 and 25 are new material necessary to complete the story of a highway bridge installation and give some suggestions on the preparation of surveys and profiles of sites, forms for contracts, bonds and other legal papers; also fourteen or fifteen pages of cost data. Many of these data are undated and, without corresponding labor rates, must necessarily be considered relative rather than indicating any present figures.

The specifications for bridges do not mark any radical departure in specification writing or call for any ex-

tended review. The requirements are generally clearly and concisely stated. The sections covering live load concentrations might possibly be improved in this respect. The frequency of motor truck loads in many localities make it advisable to state clearly whether one truck or two or more trucks are to be considered on the bridge at one time. In the loading specified for class A, the covering width for two trucks is mentioned but anything beyond this must be inferred. Under class D1 the limiting length of the covered space and the width of rear wheel tires are given but these limitations are not mentioned for classes A and B.

A number of useful designing tables have been added in Appendix III which tend to make it more complete for reference, although any bridge engineer would have the data supplied elsewhere; and in writing the statement which heads the list of these tables on p. 489 the author must have overlooked the fact that fifteen or sixteen of them are reprinted from the "Carnegie Pocket Companion."

There are many new cuts and some new inset plates illustrating detail plans, all of which are excellent, but the halftone work reflects to some extent the unfortunate condition of the paper market. The table of contents is full and better arranged for quick reference than in the first edition. The headings at the top of each page indicate the general subject under consideration and are convenient in locating chapters; the chapter number appears at the top of each left hand page. The index seems to be full and cross-referenced sufficiently to enable any particular topic to be located without waste time. This may seem like a small matter, but many a good reference book has been discarded by busy engineers for no other reason than an incomplete and unhandy index, or no index at all.

Every bridge engineer who has spent many years designing highway bridges must have his own modes of procedure fully developed, and any such will necessarily see in this book many things differing quite widely from his practice. But perhaps because of that fact, rather than in spite of it, he should welcome it the more.

Revised Tunnelbau a Valuable Book

VORARBEITEN, ERD-, GRUND-, STRASSEN- UND TUNNELBAU: Handbuch der Ingenieurwissenschaften I. Teil; Funfter Band Tunnelbau Bearbeitet von Dr.-Ing. und Dr. phil. e.h. Karl Brandau, Dipl.-Ing. Karl Imhof und Dr.-Ing. e.h. Ernst Mackensen; mit einem Nachtrag von Dr.-Ing. Erich v. Willmann herausgegeben von L. von Willmann, Geh. Baurat und ord. Professor a. D. der Techn. Hochschule zu Darmstadt. Mit 607 Textabbildungen, vollstandigem Sachverzeichnis und 14 lithographierten Tafeln sowie kurzen Lebensbeschreibungen und Bildren des seitherigen Bearbeiters Dr.-Ing. e.h. Ernst Mackensen und des wahrend der Drucklegung verstorbenen Dr.-Ing. und Dr. phil. e.h. Karl Brandau. Vierte, vermehrte Auflage. Leipzig, Germany: Verlag von Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 712; illustrated as stated above. Paper; 44 M; cloth; 56 M.

Where the engineer finds his hardest tasks, there his art is carried to its highest development. Thus shield tunneling developed in those regions in which much work had to be done in soft ground under water—first in England and later, more fully, in America. In the same way rock tunneling has reached its highest perfection in the great mountain ranges of the Alps; and, as the knowledge gained in any advance of the art tends to remain in the region of its origin, we must turn to continental literature for a record of the methods used in Alpine tunneling and the difficulties under which these methods either failed or succeeded. The work under review supplies the fullest and most recent presentation. While in form a revision of a prior edition, now nearly twenty years old, it is essentially new. In fact, many of the most difficult European tunneling enterprises, such as the Simplon and the Gattico tunnels, were carried out during the last two decades.

Though the book covers the whole field of tunneling, much of it has no special interest to the American engineer. What is given on explosives, on drills, on tunnel location and gradients, on surveys and the like will have only incidental value at best, and the section dealing with shield tunneling is sadly deficient. On the other hand, that part of the book which deals with the methods of rock tunneling merits a high rating.

An important omission mars the treatment of rock tunnel excavation: The brilliantly original Rogers Pass work is not mentioned, though it represents the outstanding contribution to the art made on this side of the Atlantic in half a century. Of course the American reader will not find it difficult to supply this omission and to co-ordinate the Rogers Pass methods with those developed abroad. In the treatment of lining operations there is an equally weighty omission, neglect of concreting, including deposition and blowing methods. In most practical cases the choice of lining method is so intimately interwoven with the determination of the tunneling procedure itself that this omission—based, of course, on the all but exclusive use of stone and brick masonry for tunnel lining in European practice—has much more far-reaching influence than might at first be supposed.

The sections of essential value for our purposes are: (1) Those describing the timbering of headings, methods of drifting in bad rock or soft ground, and the four classic methods of tunnel driving together with a further one which the authors call the Italian method, (2) those analyzing the points of merit, the weakness and the limitations of the several tunneling methods, and a special discussion of the problems presented by full-section excavation in swelling ground, and (3) a chapter on cases of tunnel collapse and how they were handled. In each instance an ample selection of practical cases is reported in detail. They evidence strikingly the growing favor of the so-called Austrian method of driving and timbering (especially with the two-center radial strutting that has displaced the earlier substrutting system, and the decline of the other methods.

There is also valuable information on the high temperatures of rock and water encountered in very long tunnels, especially the Simplon, and on the possibility of predicting temperatures. Ventilation, spray cooling and refrigeration are also well treated. Because of the influence exerted by temperature and ventilation questions on the adoption of the lateral heading system in the Simplon tunnel and the fact that quite different reasons led to the use of the same expedient at Rogers Pass, this part of the subject is likely to engage special interest.

Should our future needs call for low-grade mountain tunnels much longer than any yet built in America, it is possible that they will contain problems whose solution will lead to changes in the current methods of constructing tunnels of moderate length in sound rock. The present treatise supplies the basic information on how similar problems have been handled successfully in the Alps. The same information, however, has value

also in relation to work of less extreme magnitude, and the tunnel engineer may well accord the book a permanent place on his reference shelf.

Industrialism and War

COAL IRON AND WAR: A Study in Industrialism Past and Future—By Edwin C. Eckel, Assoc. Am. Soc. C. E. Fellow, Geol. Soc. America, Late Major, Engrs., U. S. A. New York: Henry Holt & Co. Cloth; 6 x 9 in.; pp. 375. $3.

The breadth of this interesting and suggestive study is better indicated by the subtitle than by the main title, and still better by the headings to the four parts of the book: (1) The Growth of Modern Industrialism; (2) The Material Bases of Industrial Growth; (3) The Causes and Effects of Industrial Growth; (4) The Future of Industrialism. Chronologically, the book deals with the last century and half; geographically, it is world wide; topically, the author considers population, natural resources (by no means confined to coal and iron), manufacturing industries, invention and discovery, price changes, the worker, the corporations, the state in relation to industry, political beliefs, and world competition. The closing chapters are on Industrialism and War and The Forms of Future Progress. A moderate amount of statistical evidence in the form of tables and diagrams is given.

The use of the word "war" in the title leads one to expect from the author a conclusion as to the relation between war and industry in the future. For the immediate present, the author sees more liklihood of nationalism than of internationalism, but with hopes of "co-operation of strong national units, each freely developing along its individual line." The concluding paragraphs of the book sum up the author's conclusions as follows:

> Finally, partly as the result of the fiscal necessities of the nations, we seem likely to witness an intensified nationalism everywhere, and this will be expressed in its industrial relations by high tariffs and by attempts to make the respective nations self-supplied. This implies, however, some degree of decentralization of industries, as compared with their present localization in a few countries; and it implies also a lessening importance of transport as compared with manufacture. In place of using a third of our coal merely to carry goods up and down the earth, we will be able to use this fuel in more directly economic ways.
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> All of these factors work together toward lessening the pressure upon our coal and iron resources; toward readjustments of the balance of power between localities and between nations; and toward throwing the trend of our future development into other lines than those which have been heretofore pre-eminent. The capital and labor which would formerly have been employed in transport and the cruder manufactures will in future be free to take up other lines of activity. As to the direction of such activity, we can only suggest that the trend of future development is likely to be along chemical rather than mechanical lines.
>
> In areas favored by abundant natural resources, and protected by strong industrial and military power, future industrial growth will tend to lessen class friction, rather than to increase it. But the fact that France, Britain and America, under such conditions, are likely to develop politically as pure democracies, with a large measure of individual freedom and activity, should not blind us to the fact that there are other nations, not so favored, whose development may take other courses. It is questionable, for example, if the reaction from a broken-down autocracy in Russia, Germany or Japan will result in a government democratic in form, for in each case there are natural or artificial limitations, at present, on the economic possibilities of these nations; and these limitations tend to lower the average of well-being, and to increase class friction. We are likely, then, in the future to face wide differences in political ideas as well as in prosperity, between the members of two powerful groups of nations.
>
> In the end, then, we come back to the fact that there are very serious material difficulties in the way of future peace. These difficulties are of natural origin, being ultimately dependent upon the unequal distribution of important natural resources. They may act directly, as in the case of the coal of Westphalia and China, the iron of Lorraine, the oil of the Caspian and Caribbean—all of which may serve as immediate causes of war or as the bases for that competition which is in the end more crushing and deadly than war. Or they may act through their effects upon political development, so as to create the possibility of international conflicts.

The book should have a special appeal to all broad-minded persons, and especially to engineers who wish to visualize world actions and reactions in the light of the industrial, political and social development of the last one hundred and fifty years and especially of the Great War.

Water-Power Resources of India

PRELIMINARY REPORT OF THE WATER POWER RESOURCES OF INDIA: Ascertained During the Season 1918-19 by the late G. T. Barlow, C. I. E., Chief Engineer, Hydro-Electric Surveys, Government of India. Assisted by J. W. Meares, M. Inst. C. E., M. I. E. E., M. Am. I. E. E., Electric Adviser to the Government of India—Compiled by J. W. Meares, Chief Engineer, Hydro-Electric Survey of India. Calcutta, India: Superintendent of Printing. Paper; 8 x 13 in.; pp. 108; illustrated. 3-2 Rupees.

In the first attempt to gather and compile comprehensive data on all the water-power sites in a territory so large as India, much pioneering work was required. Circulars outlining "practical conditions in determining the value of water power for electrical purposes" were distributed and the report itself contains much matter apparently intended for those not specially trained in water-power development, but whose aid would be valuable in compiling further data. Future plans and the needs in carrying the power survey further are given much space because of the difficulties involved in the work. On the latter point the report states: "Very little is known about the water-power resources of India and Burma because they mostly lie in the hills and jungles which are sparsely inhabited and rarely visited by any officials; only rough survey maps exist of many parts." It might also have been noted that absence of means of communication and the danger of disease increased the difficulties of the survey. Mr. Barlow contracted smallpox during the course of the investigations in the interior and died very suddenly. The work was then taken up and the report completed by his assistant, J. W. Meares.

All power sites on which data were gathered, whether favorable or unfavorable, are listed in paragraphed descriptions arranged by states. A table of existing hydro-electric plants in India gives data on 18 plants developing a total of about 108,300 hp. Of this total, 67,000 hp. is in the Tata development in the western Ghats.

Weather and climatic conditions are discussed in detail. In some districts monsoons, which cause highly concentrated precipitation, make for unusual problems in getting rid of the surplus water. Locations where as much as 35 in. of rainfall in one day are recorded, as well as an annual precipitation of over 400 in., which occurs in a small portion of the western Ghats. The larger part of the area examined, however, has moderate or low precipitation.

No estimate of the total water power available in India is hazarded because of the fragmentary nature of specific data, but in districts where comparatively complete data were available a few developments of large size are reported feasible. An example of this is the 50,000 hp. found available on the Jaldaka River in Bengal, within easy transmission distance of the tea area of the Duars. Here "some 90,000,000 lb. of tea are prepared in a season requiring the equivalent of 85,000 tons of coal, of which 60 per cent is used for drying purposes—to heat air, driven through the leaf at a temperature of 220 deg. F." The tea industry, however, requires power only from April to December.

The report is supplemented by a large general map of India on a scale of 1 in. to 64 miles, on which lines of equal rainfall are plotted and locations of power sites are shown by conventions that classify them as follows: Developed, under construction, investigated, and probable and possible sites.

PUBLICATIONS RECEIVED

AIR FORCES ON CIRCULAR AXES NORMAL TO THE WIND, WITH SPECIAL REFERENCE TO DYNAMICAL SIMILARITY—By Hugh L. Dryden, Assistant Physicist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 30; illustrated. 5c. from Superintendent of Documents.

A study of wind pressure coefficients made with cylinders of from 1 to 6 in. diameter with velocities from 15 to 80 miles per hour made in the 54-in. wind tunnel of the Bureau of Standards.

AMERICAN RAILROAD ASSOCIATION: Proceedings, 1919—New York and Chicago, Ill.: The Association. Cloth; 6 x 9 in.; pp. 737; illustrated.

CAPILLARY MOVEMENT OF SOIL MOISTURE—By Walter W. McLaughlin, Senior Irrigation Engineer. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 70; illustrated. 15c. from Superintendent of Documents.

THE CHEMICAL ANALYSIS OF STEEL-WORKS' MATERIALS—By Fred Ibbotson, B.Sc., F.R.C. Sc.I., F.I.C., Joint Author of Brearley and Ibbotson's "Analysis of Steel Works' Materials." New York: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 296; illustrated. $7.50.

THE COLUMBIA BASIN IRRIGATION PROJECT; A Report by Columbia Basin Survey Commission, State of Washington, 1920—Olympia, Wash.; The Commission. Cloth; 6 x 9 in.; pp. 185; illustrated.

Report on studies for a gravity irrigation project to serve 1,753,000 acres of land in Washington. An article based on the report appeared in *Engineering News-Record*, Nov. 11, 1920, p. 944.

ELEMENTARY FORGE PRACTICE: A Text-Book for Technical and Vocational Schools—By Robert H. Harcourt, Instructor in Forge Practice, Leland Stanford Junior University. Second Edition. Enlarged. Peoria, Ill.; The Manual Arts Press. Cloth; 5 x 8 in.; pp. 154; illustrated. $1.50.

ELEMENTARY MACHINE SHOP PRACTICE—By T. J. Palmateer, Instructor in Machine Shop Practice, Leland Stanford Junior University, Palo Alto, Calif. Peoria, Ill.; The Manual Arts Press. Cloth; 5 x 8 in.; pp. 123; illustrated. $1.50.

HANDBOOK OF PIPE: Comprising Tables, Charts and Other Useful Information Relating to the Subject of the Carrying of Fluids and Gases by Pipe; Pipe Installation and Test Data, etc. New York: The East Jersey Pipe Company. Paper; 5 x 7 in.; pp. 213; illustrated.

Interspersed with and following matter relating to the pipe made by the publisher are tables and other useful data on pipe, conduit design and related topics.

HISTORY OF THE TWENTY-SIXTH ENGINEERS (WATER SUPPLY REGIMENT) IN THE WORLD WAR: Sept., 1917—March, 1919—For Sale by H. J. Angell, Gould Manufacturing Co., 16 Murray St., New York, N. Y. Cloth; 6 x 9 in.; pp. 258; illustrated.

Reprinted from the December, 1919, Journal of the New England Water Works Association. Besides the story of the regiment as a whole there are sketches of each of the six companies, of the headquarters and medical detachments, and of various officers. Halftone plates, maps, diagrams and cartoons add to the interest of the History.

AN "IDEAL SECTION" ON THE LINCOLN HIGHWAY: A tabulation, with Summary and Comments, of the Replies Received in Response to the Lincoln Highway Association's Questionnaire Regarding Plans and Specifications for An Ideal Section—Detroit, Mich.: The Association. Paper; 6 x 9 in.; pp. 16; illustrated.

INDUSTRIAL SURVEY IN SELECTED INDUSTRIES IN THE UNITED STATES, 1919: Preliminary Report, Prepared under the Supervision of Allan H. Willett, Professor of Economics, Carnegie Institute of Technology, Pittsburgh, Pa. Washington, D. C.; Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 509; illustrated.

A study of hours and wages in 28 industries located in 43 states and including 2365 establishments, 780 occupations and 404,758 wage earners.

LEHRBUCH DER EISEN-UND STAHLGIESSEREI: Verfasst Fur Den Gebrauch Beim Unterricht, Beim Selbststudium Und in Der Praxis—Von Bernhard Osann, Ordentl. Professor and der Bergakademie in Clausthal Geh. Bergrat Ehrenmitglied Des Vereins Deutscher Giessereifachleute. Vierte, Nue Bearbeitete Und Erweiterte Auflage. Paper; 7 x 10 in.; pp. 672; illustrated. 42m; cloth, 54m.

THE MAKING, SHAPING AND TREATING OF STEEL—By J. M. Camp and C. B. Francis. Second Edition. Pittsburgh, Pa.; The Carnegie Steel Co. Leather; 5 x 8 in.; pp. 614; illustrated. $5.

THE MERCHANTS' ASSOCIATION OF NEW YORK: Year Book, 1920—New York: The Association, Woolworth Building. Paper; 7 x 10 in.; pp. 334; illustrated.

Contains annual reports and alphabetical and classified membership lists.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Annual Report, 1918 and 1919—Trenton, N. J.; The Board. Cloth; 6 x 9 in.; pp. 131 and 180.

NEW YORK STATE CONSERVATION COMMISSION: Report, 1918—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 426; illustrated.

NEW YORK STATE ENGINEER AND SURVEYOR: Report for 1918-1919—Albany, N. Y.: Office of the State Engineer and Surveyor. Cloth; 6 x 9 in.; pp. 363; illustrated.

PRESERVATIVE TREATMENT OF WOOD POLES—By R. V. Achatz. Lafayette, Ind.: Engineering Experiment Station of Purdue University. Paper; 6 x 9 in.; pp. 54; illustrated.

Based on available printed matter and experiences with poles in Indiana, the latter gathered by correspondence and by inspection in situ.

PUBLIC HEALTH AND HYGIENE: In Contributions by Eminent Authorities—Edited by William Hallock Park, M. D., Professor of Bacteriology and Hygiene, University and Bellevue Hospital Medical College, and Director of the Bureau of Laboratories of the Department of Health, New York City. New York and Philadelphia: Lea & Febiger. Cloth; 6 x 9 in.; pp. 884; illustrated with 123 engravings. $10.

RAILWAY COMMISSIONERS OF NEW SOUTH WALES: Report, 1920—Sydney, Australia: The Commissioners. Paper; 8 x 13 in.; illustrated.

RAILWAY EARNINGS IN 1919: Compiled from Reports to the Interstate Commerce Commission of Railways Having Annual Operating Revenues above $1,000,000—Washington, D. C.: Bureau of Railway Economics. Paper; 6 x 9 in.; pp. 18.

REFORESTATION PROGRESS IN PENNSYLVANIA—By Jacob L. Crane, Jr. Reprinted from The American City, N. Y. Cambridge, Mass.: The Author, 1 Frost Terrace. Paper; 7 x 10 in.; pp. 4; illustrated.

THE RELATION OF FLOOD CONTROL TO DRAINAGE—By Thorndike Saville, Associate Professor of Hydraulic and Sanitary Engineering, University of North Carolina. Paper; 6 x 9 in.; pp. 7.

STATISTICS OF RAILWAYS IN THE UNITED STATES: Report, 1918. Prepared by the Bureau of Statistics—Washington, D. C.: The Bureau. Paper; 9 x 12 in.; pp. 91.

STEAM POWER—By W. E. Dalby, F. R. S., Member of Council Inst. of Mechanical Engineers, London University Professor of Engineering at the City and Guilds Engineering College of the Imperial College of Science and Technology. Second Edition. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 10 in.; pp. 760; 250 diagrams. $12.

Apparently a reprint (without change except in price, which has been doubled) of the book as it first appeared in 1915. The book was reviewed at length by Prof. Carl C. Thomas, Johns Hopkins University, in *Engineering News-Record*, Feb. 17, 1916, p. 320.

UTILITY REGULATION AND RATE OF RETURN—By Cecil Y. Elmes, Chicago Manager Sanderson & Porter, American Electric Railway Association, Annual Meeting, Oct., 1920. Paper; 8 x 11 in.; pp. 37; illustrated.

Holds that utilities are completely regulated and other industries are entirely unregulated to the detriment of utilities, and appears to argue for regulation of the other industries. Urges also that money market is not regulated and although utility commissions may "specify a rate of return, the utilty has no certainty of receiving it." Favors "progressively greater profit" to utilities "for progressively improved service to the public."

THE WESTERN FARMER'S WATER RIGHT—By R. P. Teele, Irrigation Economist, U. S. Department of Agriculture. Washington, D. C.: The Department. Paper; 6 x 9 in.; pp. 14.

WINGS OF WAR: An Account of the Important Contribution of the United States to Aircraft Invention, Engineering, Development and Production During the World War—By Theodore Macfarlane Knappen; With an Introduction by Rear-Admiral D. W. Taylor, Chief Constructor, U. S. N. New York: G. P. Putnam's Sons. London: The Knickerbocker Press. Cloth; 5 x 8 in.; pp. 289; illustrated. $2.50.

Suspiciously like an "inspired" review of our war-time airplane activities. Turns the searchlight on certain fine accomplishments but ignores dangerous mistakes and particularly the lack of coordination in aircraft production.

LETTERS TO THE EDITOR

The Worm Turns

Sir—As a subscriber to *Engineering News-Record* I wish to enter a respectful protest against both the matter and the manner of the articles which have appeared from time to time in your columns under the caption, "What Is Art?"

To your editorial judgment it may seem profitable to permit the discussion of points concerning which there is a difference of opinion between the architectural and engineering professions. If these questions can be discussed amicably both sides of the debate will be profited thereby; but when the discussion is permitted to evince the spirit apparent in some of the late articles, it would seem to the writer to be a serious mistake to publish any portion of it. For however much we may disagree upon moot points, architects and engineers are members of the one great family of builders, and must perforce "get together" for the furtherance of their common objects.

In the writer's estimation the worst offence is that in your issue of Sept. 23 over the signature of John C. Trautwine, Jr.

His vicious attack upon the time-worn puppet reminds one for all the world of a familiar stunt of childhood days, when we used to show the neighbor's little girl how brave we were by vanquishing a snow dragon which we had previously been at much pains to set up. I doubt very much if Mr. Trautwine could furnish a single example of either bridge or building design in which an architect would succeed in combining "meaningless pylons," "meaningless rock fortresses," a "meaningless sheet iron arch across each panel," and "a meaningless cast-iron cauliflower at each panel point." In the first place, an architect of sufficient repute to be entrusted with so important a commission would not be a designer capable of producing a design so meaningless; and secondly, if such a thing were possible, no client would pay for it. The paying public are not all afflicted with damphoolitis, Mr. Trautwine apparently to the contrary notwithstanding.

The fact that when a structure is to appear in "some place where large numbers of . . . persons foregather, an architect must be called in" is pretty conclusive proof that the majority of people have not yet arrived at that point of development where they are ready to subscribe to the creed that "the difference between the engineer's and the architect's training, which makes the engineer the authority on strength, makes him also the authority on beauty." And judging from the history of the last few thousand years, with which Mr. Trautwine does not seem to be particularly familiar, few of us will live to see the time when they will. As a matter of fact, with the costly failure of a certain Canadian bridge still fresh in our minds, there is a substantial majority among the older members of both the architectural and the engineering professions who would hesitate to go on record as believing that the engineer is invariably "the authority on strength." When it comes to professional blunders, the architects can hardly be said to possess the monopoly.

The man who can argue that a thing is beautiful because it fitly performs its function should spend his next vacation by the seashore catching devil-fish. Like the man who has to be told when to laugh, he lacks a very essential bone in his anatomy. If it were not for the overworking of Brother Trautwine's pet adjective, I would be tempted to retort that that is what his criticism is.

In a later number Rudolph Hering, consulting engineer, cites a horrible example from the wild and woolly days of American building as an instance of what "the Romans would never have endorsed and Americans will never repeat." Aside from the demerits of the particular design to which he refers, if the writer is not at fault in matter of architectural history, it was the Romans themselves who first invented the system of decorating structural members with "meaningless" ornament applied to the exterior for the sole purpose of making their otherwise severely plain arches and vaults interesting. And the civilized peoples of the world have "endorsed" their scheme by repeating it throughout a couple of thousand years. Perhaps consulting engineers have ways of knowing what the ancients would endorse which plain architects and engineers wot not of. Or it may be that they are more expert in the use of the Ouija board. Be that as it may, after having viewed the remains of certain Roman structures which were erected centuries before the slide rule and the testing machine were even dreamed of, the writer is quite willing to believe that few of the Roman designers would have been ready to subscribe to the thesis that "the greatest beauty of form in a structure and its parts is secured by giving the required resistance to every attacking force with the least amount of material, and in the simplest and most direct way." At least they would be likely to accept with reservations.

For a term of years the writer has been engaged with both architects and engineers in work upon various projects, and he credits himself with a mind sufficiently broad to enable him to see and to appreciate the better qualities of both; but that same experience long ago cured him of the notion that either the one or the other possessed the mentality sufficient to constitute one an infallible authority upon every question connected with his own and allied professions.

Winthrop Highlands, Mass. GEORGE E. DORMAN.
Oct. 29.

On Throwing Bricks

Sir—In your issue of Sept. 16, p. 572, you publish my letter of Sept. 4, with an editorial comment following it which seems to me to indicate that you gathered from said letter that I was about ready to heave a brick. Such is not the case.

However, I maintain my point, "that force is the one thing that counts in the case of large industrial corporations dealing with their employees." The comparatively few exceptions do not disprove the rule. It is not always a case of heaving bricks; but it is potential force, which may or can be exerted, that is respected. That is why the A. A. E. succeed with the railroads. We do not need to "sink to a very low order" to be able to recognize the fact that force rules industry today; and I think it is rather the labor unionists who "keep their heads" and their self respect, rather than the technical engineers.

I would like to dispel from your mind, and the minds of your readers, the thought that I in any way advocate or tolerate throwing bricks—except as a last resort. I stopped shooting rabbits for fun soon after my first vote.

CHARLES A. MULLEN,
Montreal, Nov. 10. Consulting Paving Engineer.

Recovery of Vortex Energy in the Niagara Turbines

Sir—Mr. Horton's article on "Modern Developments of Hydraulic Turbine Design," Oct. 7, 1920, p. 683, contains a rather glaring error in his portion under "Minimum Constraint Desirable," in which he says, "as everyone knows, water can only enter the buckets without shock when it approaches the wheel with a tangential component of velocity equal to the peripheral velocity of the runner." Everyone knows this is not so except in case of a runner with entrance angle 90 deg., and is far from so in the case of the high-specific-speed turbine.

Mr. Moody with the "Center cone" and Mr. White with the "Hydrau cone" both claim to recover part of the tangential component of the water leaving the runner, under part or overgate. They no doubt do, but they give no reason for change of this vortex energy to pressure energy. Mr. Horton blames it on De Vilamil and Helmholtz. The writer believes this is nothing more than a free vortex between approximately parallel plates, similar to that which has been used for thirty years around the impellers of centrifugal pumps for identically the same purpose, i.e., changing the energy of vortex motion to pressure energy, some of the energy being lost in friction. The path of a particle through such a free vortex is the equiangular or logarithmic

spiral, both the radial and tangential components of the velocity decreasing inversely as the distance from the center of the vortex. The coinical draft-tube fails to recover the vortex energy and there is no reason why these new devices should not be very successful and their application to turbines become more general.

Philadelphia, Oct. 29. W. S. PARDOE,
University of Pennsylvania.

Shrinkage of Earthwork

Sir—The experiments made by the Chicago, Burlington & Quincy R.R. under the direction of Mr. Marshall, reported in *Engineering News-Record* of Oct. 21, 1920, p. 782, concerning the influence of the density of the earth upon the shrinkage of the embankments are not conclusive because not complete, and are based on a certain assumption. The assumption is that the embankments were built with earth taken alongside the fills and that consequently the material both in the cuts and in the fills is of the same identical quality. Such an assumption is not correct, especially in old embankments where the disintegrated ballast has found its way to a considerable depth into the soil of the fill, so that after many years the earth in the bank is different from the original cut. A comparison of the density of these two materials has no significance since the earth in the embankment has been greatly modified by the ballast and reballast of the roadbed. The discussion of the theories is generally based on assumptions, but not the experiments. Besides the experiments made by Mr. Marshall are not complete since the physical and mineral examination of the materials taken from the cuts and fills was neglected. Notwithstanding these objections which may have altered the results, the experiments prove my contention that the earth removed from the natural banks when deposited in embankments swells, and if the measure does discover a decrease of volume, this must be attributed to the losses in transportation and by rain erosion.

The diagram on p. 782 indicates that the earth of 103 lb. weight does not swell or shrink, and consequently is at the neutral point, while a heavier one swells and a lighter one shrinks. Curve "B" shows that all the earths below 4 ft. from the surface are heavier than 103 lb. and consequently swell. Now a material that shrinks or swells according as it is taken above or below the 4 ft. line proves that these phenomena are independent of the nature of the material, but caused by the particular condition of its particles as found at various depths. The apparent strange phenomenon is easily explained. When the cohesion is destroyed the particles get loose, the unit of volume becomes lighter on account of the larger number of voids which are formed. When such a material is subjected to pressure, the particles get close together and the earth shrinks. The earth, however, does not shrink when its particles are more compact and have not been disturbed from their natural position.

The result of the experiments is that the earth taken from a cut at a depth of more than 4 ft. swells, while if it is taker at a smaller depth it shrinks. This means that the earth down to the frost line should not be considered as in its original natural condition, because its cohesive force has been destroyed by successive freezing and thawing. The particles have been disturbed from their original natural position, many voids are now encountered in the mass, which tend to reduce the weight of the material as shown in curve "B" which also indicates that below the frost line the earth is not only heavier, but its weight is almost constant.

Any earth in which the force of cohesion has been destroyed (no matter if by removal from its natural position, or by freezing and thawing) will not be able safely to support any structure, and for this reason we are taught that "in any soil the foundation of any structure should be below the reach of the frost." No wonder that an embankment supporting a railroad track built above the frost line will sink under the pressure of the traffic. This is the so called subsidence of the embankment estimated tentatively by Mr. Marshall at 3 per cent. Curves "A" and "B" clearly indicate that the earth taken from the cuts above the frost line or down to 4 ft. from the surface have lost already their natural cohesive force although apparently they are in their natural position, a fact which was well known and admitted by everybody.

Besides, the experiments show that the volume of the earth in the embankment is always larger than in the cut. In fact, curves "C" and "D" indicate that humidity at any depth is greater in the fills than in the cuts. Difference in humidity in two materials considered equal and taken from the same locality proves that one has more voids which are filled with water, and one with larger number of voids weighs less and under equal weight or metallic content has a larger volume, hence it swells and does not shrink.

Mr. Marshall has not attached importance to the losses in transportation and by rain erosion during construction, and by the continuous erosion during the life of the embankment. These items, he says, may be covered by "adding some small percentage based upon opinion of many competent minds." This is not very instructive. Mr. Tratman, for instance, says: "One of the great troubles from heavy rainfalls is the gullying out of the slopes and the breaking down of the corners of cuts and banks." Heavy rains are an ordinary occurrence and consequently a great deal of material is carried away from the embankments and requires the continuous clearing of the ditches. No one has mentioned the ballast continuously added to the roadbed, which, when disintegrated, is incorporated in the embankment. Taking into consideration what has been added to the embankment since its construction, and comprising the original volume of the earth deposited with the present volume, it will be seen that the losses by erosion are not so insignificant.

The "shrinkage" of the earth in embankments is discussed under two different points of view, technically and practically. My contention is only theoretical. Earth is considered as one of the materials used in engineering construction, and the shrinkage and swelling are discussed as properties of the material itself. The railroad people discuss the question from the practical point of view of determining the actual value of the embankment, and have based some of their claims on the shrinkage of the earth, and in this I claim they are in error. CHARLES PRELINI.

New York City, Nov. 9.

Loss of Head in 12-in. Gate Valve; Correction

Sir—In an article by Thomas E. Lally on loss of head in a 12-in. gate valve in a 16-in. pipe line, in your issue of Sept. 23, p. 608, there is an apparent error in paragraph 3, in which he says that carbon tetrachloride (specific gravity, 1.60), when used in a U-tube, is eleven times more sensitive than mercury (special gravity, 13.56). This should read 20.9, as the formula for the use of the differential gage is loss head = gage deflection x (specific gravity of liquid—one) or

$$\frac{13.56 - 1}{1.60 - 1} = 20.9$$

I hope and believe this is an error in statement and does not effect the results quoted, which seem to check very closely the loss of head curve shown on p. 589 of the same issue. W. S. PARDOE,

Engineering Department, University of Pennsylvania, Philadelphia, Sept. 28.

Sir—I wish to thank Professor Pardoe for calling attention to the mistake mentioned above. In the hand-written draft of the paper 21 was written in numerals. This was typewritten eleven, probably due to poor figures. As my calculations were made independent of the paper the error of statement does not affect the results of the tests.

Boston, Nov. 3. THOMAS E. LALLY.

HINTS FOR THE CONTRACTOR

Building Plant on Sidewalk Provides for Convenience of Traffic

BY PARTIAL occupation of a sidewalk with construction plant and material building alterations on a narrow street in the congested loop district of Chicago are being carried on with a minimum of obstruction to vehicular traffic and to occupants of the building. This work is at the Hamilton Club on South Dearborn St., the original building being part nine and part three stories high, all to be built up to fifteen stories without interfering with occupancy except at the top floor.

CONSTRUCTION PLANT FOR BUILDING WORK ON BUSY STREET

About 10 ft. of the width of sidewalk is utilized for a distance of 100 ft., leaving a 6-ft. space along the front of the building for pedestrians. The partition extends up to a substantial working platform which is built over the full width of the sidewalk at the second story level, this platform being used for power saws and storage. The tunnel thus formed is painted and well lighted in order that stores on the first floor may suffer as little as possible. Signs for these stores are displayed also on the street side of the working platform.

A two-compartment hoisting tower is erected on the sidewalk, its maximum height being 220 ft. In one compartment is a concrete hoist, the 1-yd. bucket being charged by a ¾-yd. mixer on the sidewalk and discharging into a hopper for filling wheelbarrows at the floor levels. In the other compartment is an elevator for materials. Platforms erected between the tower and the building and on the north side of the tower provide for handling material on two sides of the elevator. These platforms are supported by inclined struts framed against the posts of the tower. Access to the lower part of the work is by a wide Jacob's ladder reaching from the working platform to the fourth floor. Similar ladders extend from floor to floor in the upper portion.

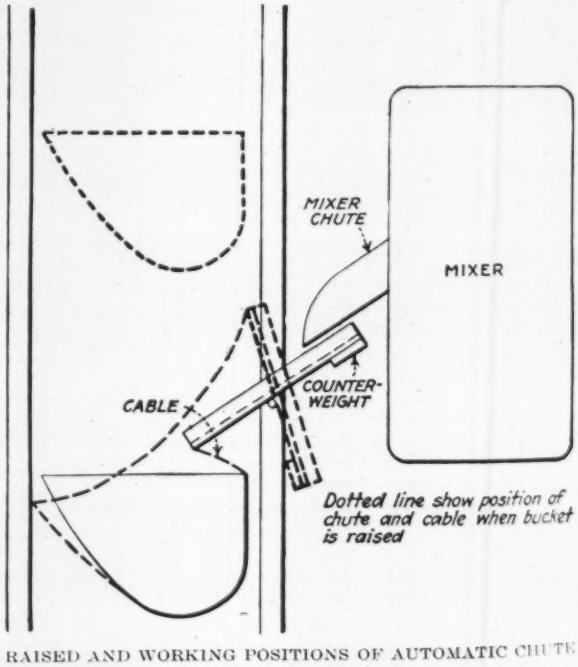
The new steel framing is erected by means of a steel derrick with 80-ft. boom which hoists structural material directly from the street. Lumber and reinforcing steel which cannot be handled conveniently in the elevator are hoisted by a short boom on the tower.

This work is being done by the Wells Brothers Construction Co., Chicago. E. E. Roberts is architect, the Westcott Engineering Co. acting as structural engineers and the Condron Co. as mechanical engineers.

Automatic Chute Connects Mixer and Hoist Bucket

BY S. WARREN
New York City

IN DUMPING concrete from a mixer into the hoist tower bucket, a chute must be used. The accompanying sketch shows a simple method of making this chute automatic in operation.



RAISED AND WORKING POSITIONS OF AUTOMATIC CHUTE

The chute, fastened to the hoist tower, is set slightly off center and counter-weighted so that the heavier end is outside the tower. When the bucket is raised it lifts

this chute to a vertical position, so that the bucket clears the chute when the bucket is again lowered. To bring the chute back to an operating position a cable is fastened to the end of the chute inside the tower. The other end of this cable is fastened to the other side of the tower. When the bucket is lowered it hits the cable and brings the chute into the proper position for dumping.

High Set Derricks Erect Building From Single Position

FOR the steel erection of the Ambassador Theater at State and Lake Sts., Chicago, two large steel guyed derricks were installed in the open space of the main floor, and were placed at a sufficient height to handle the entire work at one setting. One derrick was mounted on a timber trestle tower 36 ft. high, standing on the basement floor. The other derrick rested on bolsters having one end supported by a truss framed between two balcony trusses, and the other end by a single timber bent, as shown in the accompanying view.

HEAVY STEEL ERECTED BY TALL ELEVATED DERRICKS

The site is 170 x 155 ft. and the height from basement to top of steel is 120 ft. Each derrick has a 115-ft. mast and 105-ft. boom, the maximum working reach of boom being 100 ft., with a hoisting capacity of 20 tons at that reach.

Trusses supporting the balcony had to be erected in advance of other steelwork to permit of concreting the columns, these columns being braced temporarily by timber struts. Each of these trusses was shipped in one piece, two weighing 65 tons each and the other 48 tons. They were hauled by teams from the railway yard to the site. Some of the large stage trusses, in the framing at the left of the view, were assembled at the basement level and hoisted complete, the heaviest trusses weighing 75 tons each.

This erection work was done by the Overland Construction Co., Chicago, the steel work being built by the Federal Steel Bridge & Structural Co., Waukesha, Wis. The architects were C. W. and Geo. L. Rapp, and the structural engineers were Lieberman, Klein & Hein.

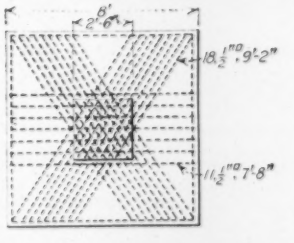
Handle Steel and Timber with Care

ROUGH handling of structural material is a practice about which foremen should be cautioned carefully and persistently, as it is a rather common condition in spite of the obvious chances of more or less serious injury to the material. As an instance, at a building of steel frame construction the columns and beams have been unloaded from motor trucks by throwing them off with crowbars and allowing them to drop upon the paving or upon material previously unloaded. Riveted connections are likely to be bent or loosened by such treatment, but more serious is the possible injury to the members themselves. The necessity of careful handling and unloading of steel rails in order to avoid shocks and sharp blows is generally understood, but it is not so well recognized that the same necessity exists in the case of steel beams and columns. Plate girders, also, are sometimes subjected to unintended stresses when laid on their sides for handling, or when laid flat upon blocking in such a way as to sag and bend, being used sometimes in that position as platforms for storing other material. Further, large structural timbers and wood piles are liable to damage when thrown from cars or trucks, especially if the timbers have been treated by a preservative process. Two points to be guarded against, therefore, in construction work, are careless unloading by material men or truckers and careless handling in storage or erection.

Simplifying Three-Way Reinforcement

BY GEORGE OXFORD
Detroit, Mich.

A NOVEL arrangement of reinforcing bars in rectangular bases for concrete columns was used recently in a Detroit factory building, as sketched herewith. Only two different lengths of bars were required for square bases, and only three for rectangular ones were straight, and wired together in the bar shop they formed rigid units, easily handled and placed.



SQUARE BASE WITH SIMPLE REINFORCEMENT

The design of such reinforcement is as simple as its use. Moments are taken about any line adjoining the projection of the shaft of the column, and the required amount of steel and concrete apportioned as usual. Care is taken, naturally, to consider only that component of the stress in the bar which is normal to the axis of moment. Since diagonal bars are longer than bars placed otherwise there exists a better condition for development of bond.

NEWS OF THE WEEK

New York, November 18, 1920

National Research Council Forms Comprehensive Highway Investigating Body

Advisory Board on Highway Research to Co-ordinate All Research Agencies—Federal Aid to Be Sought

In the hope of soon securing sufficient funds from the Federal Government with which to employ highly trained and experienced research men, in order that that mass of fundamental data which underlies the economic construction of the modern type of highway may be secured and distributed among roadbuilders throughout the country, representatives of twelve technical and other organizations, as well as men from five engineering colleges, met at the call of the Engineering Division of the National Research Council, Nov. 11 in the Engineering Societies Building, New York City, and formed the Advisory Board on Highway Research, appointed a permanent chairman, an interim secretary, a number of committees and formulated a definite plan of action.

Those bodies represented by one or more members at the organization meeting included the following: American Association of State Highway Officials, American Society of Testing Materials, Society of Automotive Engineers, Bureau of Public Roads, National Automobile Chamber of Commerce, American Society of Civil Engineers, American Institute of Consulting Engineers, American Society of Mechanical Engineers, Association of State Geologists, Western Society of Engineers, American Concrete Institute, and the American Automobile Association. In addition, engineering professors from Harvard University, Yale, the University of Maryland, the University of Illinois and Iowa State College, were present and took part in the discussions and organization of the research board.

NATIONAL PROGRAM OF RESEARCH

The general highway conference was called after the National Research Council had been convinced of the necessity of co-ordinating all research agencies for the early accumulation of data necessary to the economic design and construction of hard-surfaced highways. Quoting from by-laws of the new board it will exist to "assist in outlining a comprehensive national program of highway research and co-ordinating activities thereunder; to organize committees for specific problems; to deal with ways and means; and to act in a general advisory capacity." As committees to handle specific problems are those on (1) Bibliography; (2) Economic Theory of Highway Improvement; (3) Structural Design of Roads; and (4) Character and Use of Road Materials. After these committees have surveyed their respective fields of activity, reports will be made back to the General Advisory Board as to what specific subjects should be taken up.

It is the intention of the Advisory Board on Highway Research to secure a definite assignment by Congress of a certain portion of the unexpended balance of Federal-aid road money to some agency which will administer the funds under the direction of the advisory board. It is hoped that sufficient funds may be immediately made available to allow the research work to begin at once, and to admit of the employment of a corps of highly trained

(*Continued on p. 1014*)

Pasadena Adopts Commission-Manager Form of Government

The commission-manager form of city government was adopted by the voters of Pasadena on Nov. 2. Seven "directors," elected by popular vote, will appoint a city manager who in turn will select all other city executives.

"Transportation" To Be Keynote of A. S. M. E. Session

The "keynote" session on Transportation which will occupy an entire day of the annual meeting of the American Society of Mechanical Engineers, to be held at the Engineering Societies' Building, 29 West 39th St., New York City, Dec. 7-10, will include an address by Daniel Willard, president, Baltimore & Ohio R.R., on the railroad situation. Charles A. Morse, chief engineer, Chicago, Rock Island & Pacific Ry., will speak on the development of railroad feeders, and Maj.-Gen. Frank T. Hines, chief of embarkation during the war, who is now chief of transportation in charge of all army transport, will speak on the development of waterways. Motor truck transportation problems will be outlined by Francis W. Davis, transportation engineer, Pierce-Arrow Motor Car Co., and the railroad terminal problem will be presented by Col. William Barclay Parsons. The freight situation of New York City will be discussed by Gustav Lindenthal.

An announcement of the meeting appeared in *Engineering News-Record*, Oct. 21, p. 819. The transportation session is to take place Dec. 9.

New York Board of Examiners Named

A board of five members has been appointed by the University of the State of New York to administer the engineers' registration law passed by the State Legislature last summer. It consists of Col. W. J. Wilgus, P. A. Barhour, H. G. Reist, V. M. Palmer, and E. H. Hooker, representing respectively the civil, mining, electrical, mechanical, and chemical branches of engineering.

Shandaken Tunnel Work Assigned By Degnon Company

The contract for the Shandaken tunnel, which is being built under the direction of the Board of Water Supply of the City of New York to deliver water from the Schoharie watershed to the Ashokan reservoir, has been assigned by the contractors, the Degnon Contracting Co. of New York City, to a corporation specifically organized for completing the work. The assignee is the Shandaken Tunnel Corporation, incorporated by the Ulen Contracting Corporation of New York, the Fidelity and Deposit Co. of Maryland, and the National Surety Co., with a paid-in capital of $750,000.

The Ulen Contracting Corporation is associated with Stone & Webster and has done a large amount of work in the Middle West and in South America.

The Degnon Company is leaving the Shandaken job with approximately $2,000,000 worth of work completed. The seven construction and the one intake shafts have all been sunk and turned. The new contractors will take over all rights, titles and interest in the Degnon equipment at Shandaken. The original contract was let to the Degnon Co. Nov. 10, 1917, the contract price being approximately $12,000,000

State Highway Engineers Inspect Maryland System

With a view to co-ordinating the engineering work of the Maryland State Roads Commission and at the same time giving to the new members of the commission and the several resident engineers a comprehensive view of the entire Maryland highway system, John N. Machall, chairman and chief engineer of the commission, has inaugurated a series of inspection trips. The first of the trips begun the week of Nov. 8, included the Western Maryland section. Members of the commission, chiefs of the seven road districts, and representatives of the Bureau of Public Roads make up the inspection party. The second trip, to be made the week of Nov. 15, included visits to most of the Eastern Shore counties.

Nelson P. Lewis Retires From Municipal Service

Nelson P. Lewis, chief engineer of the Board of Estimates and Apportionments, New York City, will retire next month from the municipal service, in which he has been employed thirty-four years. In recognition of his work the Municipal Engineers of the City of New York, of which he was the first president, will make its sixteenth annual dinner, to be held at the McAlpin, New York City, Dec. 18, a testimonial to Mr. Lewis.

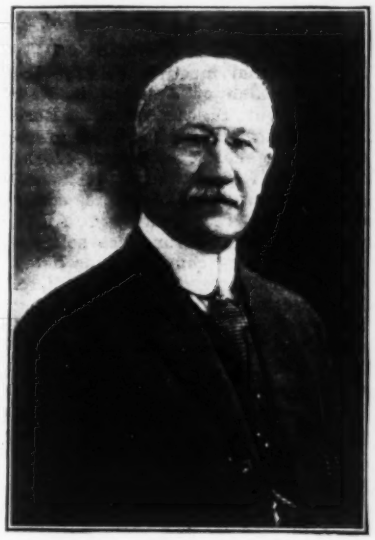
In the field of civil engineering, both in this country and in Europe, Nelson P. Lewis is a well known figure. In addition to his duties with the Board of Estimate and Apportionment of New York City, he has been active in engineering society affairs, having served as vice-president and director of the American Society of Civil Engineers, as president of the American Road Builders Association and as president of the National Conference on City Planning. He is author of the book "Planning of a Modern City."

Mr. Lewis was born in Red Hook, N. Y., in 1856, and after graduation, in 1879, from Rensselaer Polytechnic Institute he went to Colorado, devoting his time to railroad work in that state and in Louisiana until 1884, when he came to Brooklyn, N. Y., to become leveler in the Department of City Works. Since that time, with the exception of a period from November, 1886, to July, 1889, when he was engaged in railroad work in Alabama and Georgia, Mr. Lewis has been continuously in the service of the City of New York.

Mr. Lewis' early work with the city was in the highway department of Brooklyn, where he advanced from assistant engineer to chief engineer. In recognition of his efficient work he was promoted to become chief engineer of the New York Board of Estimate and Apportionment when that office was established in March, 1902. Through many changes in municipal administration Mr. Lewis has occupied this post and has passed upon the engineering features of public works improvement involving expenditures of many millions of dollars. On account of his extensive experience in problems of municipal engineering his services on special commissions have been frequently sought. In 1904 Mayor McClellan named him as a member of the New York City Improvement Commission and in 1905 he was appointed to the Commission on Municipal Electric Lighting. Later he served on the Heights of Buildings Commission, a body whose work lead eventually to the adoption of the zoning scheme in New York City. His most recent commission duties have related to snow removal and garbage disposal of New York.

Mr. Lewis has always displayed a keen interest in the design, construction, and economic features of highway improvement and was a United States representative at the International Road Congresses on three occasions—at Paris in 1908, at Brussels in 1910 and at London in 1913. His contact with foreign affairs was further strengthened in 1913 by attendance at the International Congress of Cities held in Ghent, and in December, 1918, he was one of nine engineers invited by the French Society of Civil Engieers to visit France and study its engineering problems under war conditions.

As an authority on city planning Mr. Lewis has received wide recognition. In addition to his book, previously mentioned, he has written many papers on the subject and delivered numerous lectures at engineering colleges and technical societies.



NELSON P. LEWIS

In retiring from the arduous duties as chief engineer of the Board of Estimate and Apportionment Mr. Lewis has stated that it is not his intention to open a consulting office. It is possible, he explained, that where his advice is sought on city planning and general municipal problems he may give opinions as a consultant, but his plans do not contemplate any large scale work along these lines.

Research Information Service Begun

A research information bureau has been established by the National Research Council to act as a general clearing house in supplying information. Ordinarily this service will be rendered without charge, but where difficulties will be involved the enquirer will be furnished with an estimate of cost of obtaining the desired matter. Much of this material will be issued in the publications of the Council but it is intended to maintain complete files relative to special subjects. Inquiries should be addressed to the Research Information Service, 1701 Massachusetts Ave., Washington, D. C.

Further Details of Bond Issue Votes

Colorado Tunnel Project Defeated — Philadelphia's $33,000,000 Loan Allotted to Many Projects

Details of the $33,000,000 *Philadelphia Loan*—The items in the $33,000,000 loan bill noted in these columns last week as having been voted by the people on Nov. 2 are: Buildings, $7,520,000, sewers and sewage disposal, $4,500,000; streets, $3,850,000; elevated railway and subway, $3,600,000; docks and wharves, $3,500,000; water supply, $3,105,000; damages for street openings, etc., $2,000,000; street cleaning equipment, $1,600,000; bridges, $900,000; bathing beaches, $800,000; parks and playgrounds, $1,675,000; fire apparatus, $550,000. Some of the items were characterized on the ballots as being "towards" the improvements specified. The loan was approved by a vote of 182,506 to 54,983. Press and other local comment indicates that had the vote been on specific items the negative vote for most of the purposes listed would have been lower.

Reading Votes $1,940,000 *Loan but Defeats Parks and Playgrounds* — A bond issue of $1,940,000 for sanitary and storm sewers, paving and public comfort stations was carried at Reading, Pa., Nov. 2, but items (amounts not reported) for parks and playgrounds and the "Bingaman St. bridge lamp" were lost.

Water Bonds Voted at Vallejo; Salary Raises Defeated—A $1,250,000 bond issue to bring water from Gordon Valley to the city of Vallejo, Cal., and Navy Yard was approved on Oct. 28, by a vote of 3,612 to 359. The project includes a 2,000,000,000-gal. reservoir and a 5,000,000-gal. pipe line 12 miles long. On the same date proposed salary increases for the mayor, city commissioners and auditor were defeated by majorities of 500 to 1,000.

South Dakota Authorizes State Aid for Home Building—An amendment to the constitution of South Dakota authorizing state aid for home building appears to have been carried by a substantial majority.

No State Tunnels for Colorado—More complete returns on the vote for a constitutional amendment to permit the issue of $18,550,000 in bonds for the construction of mountain tunnels in Colorado have reversed the apparently favorable result noted in *Engineering News-Record* of Nov. 11, p. 961, the bond issue being defeated by a considerable majority. The earlier returns included Denver and the northwestern section of the state which would be benefited most directly by the proposed improvement in transportation facilities. The six-mile Moffat tunnel under James Peak, to eliminate the present high-level, steep-grade, open-pass summit section of the Denver & Salt Lake R.R., was the main feature of the project. The city of Denver at one time voted to issue bonds for this tunnel, but

the state supreme court held this to be unconstitutional. Other tunnels were to be on lines of the Denver & Rio Grande R.R., but one of the objections to the amendment was a doubt as to whether the railroad could be compelled to use the tunnels. Another argument was that if the financial prospects were as good as estimated by the advocates of the measure the projects would have been undertaken by private capital. There was also the same opposition to the system proposed for the carrying out of the project.

Pasadena Again Defeats Municipal Railway to Los Angeles—For the second time the voters of Pasadena have refused approval of a project for building a ralway to Los Angeles. The vote on Nov. 2, was 10,831 for to 3,897 against a charter amendment authorizing a $4,500,000 bond issue for the purpose, whereas a favorable two-thirds majority was necessary for approval. A charter amendment which carried authorizes 6 instead of 5 per cent interest on city bonds.

Arizona Probably Defeats Road and Irrigation Bonds and Carries State Institution Bonds— News as to constitutional amendments in Arizona is belated. Early returns indicate that $15,000,000 of road and $20,000,000 of irrigation bonds were defeated and $5,000,000 of bonds for state institutions carried.

Arkansas Road Bond Amendment Lacks Two-Thirds Majority—Although receiving a plurality, the proposed Arkansas constitutional road bond amendment lacked the two-thirds majority of the gubernatorial vote. Some doubt has been expressed as to the need for more than a bare majority.

Colorado Votes Road Bonds—A constitutional amendment passed by a substantial majority on Nov. 2 provides for a bond issue of $5,000,000 at 5 per cent for road work, under the direction of the state highway department. Half of the amount is to be used upon federal aid projects, in co-operation with the U. S. Bureau of Public Roads. The remainder is to be expended within the different counties in the ratio which the mileage of state roads in each county bears to the total mileage of state roads. Federal aid may be used also, if it is available. Bonds for this second class of work are to be issued to the amount of $1,000,000 only in 1921.

Kansas Passes Good Roads Amendment — Adoption of the constitutional amendment permitting state aid for highway construction in Kansas appears assured. This amendment is merely an enabling act. It gives power to the Legislature to provide laws whereby the state may aid in highway construction to the extent of 25 per cent of the cost, not to exceed $10,000 per mile for no more than 100 miles in any county, except in counties having an assessed valuation of more than $100,000,000 in which aid may be extended to 150 miles of highway.

State Road Bonds Defeated—The adverse vote against Carlyon $30,000,000 road bond bill in Washington noted in our issue of Nov. 2, p. 961, was 122,000 to 73,000. Other defeated state bond issues or constitutional enabling amendment thus far indicated are: *Florida*, amount unknown; *Idaho*, $2,000,000; *Montana*, $15,000,000; *Utah*, $2,000,000.

Chester County, Pa., Road Bonds Fail—A proposed Chester Co., Pa., $3,000,000 road bond issue is reported to have been defeated on Nov. 2, by 3,000 majority through the farmer vote.

Faherty Chosen President of Road Builders' Association

At its annual meeting held at the Automobile Club of America in New York City, Nov. 15, the American Road Builders Association elected as president M. J. Faherty, chairman of the Chicago Board of Local Improvements, and as secretary E. L. Powers, editor of *Good Roads*, New York City. All of the other candidates for office selected by the nominating committee, as listed in last week's issue of this journal, p. 965, were elected.

The next convention and exhibit of road building machinery and materials will be held in the Coliseum, Chicago, next February.

Water Epidemic of Typhoid Fever at Salem, Ohio

Pollution of the public water supply by leakage into an old gravity line of terra cotta pipe leading from wells to the pumping station of Salem, Ohio, is believed to be the cause of a typhoid epidemic in that city. Some 750 cases and nine deaths had been reported up to Nov. 12. Investigations are being made and restrictive measures carried out by W. H. Dittal, chief engineer of the Ohio State Department of Health and a medical and engineering staff, with the co-operation of the U. S. Public Health Service.

British Institution to Increase Dues and Avoid Deficit

With a threatened annual deficit of more than $50,000 due to increased expenses for publication and administration, the council of the Institution of Civil Engineers (London) has concluded that membership dues should be raised to provide an additional income of about $60,000 (at normal rate of exchange). It is proposed that the increase in dues shall be higher for the senior than for the junior classes of membership and that the present difference between resident and non-resident members shall be extended to make distinction between non-resident members at home and abroad. Under the proposed schedule the annual dues will be $35, $27.50 and $22.50 for resident members, non-resident members in the United Kingdom and non-resident members abroad respectively. For associate members the annual dues will be $22.50, $20 and $17.50, respectively. For students the dues will be $10 annually.

Editor Addresses Societies and Engineering Students

E. J. Mehren, editor of *Engineering News-Record*, has returned from a two weeks' trip in which he spoke before engineering societies and students of engineering colleges in the Middle West. With the exception of one address, his topic was his impression of political and industrial conditions in Europe. The addresses before the Detroit Engineering Society, the Engineers' Club of Kansas City, the St. Louis Engineers' Club the Engineering Society of Milwaukee, and the students of Purdue University were illustrated with lantern slides. The members of the Western Society of Engineers were addressed at their usual monthly public-topics luncheon. At Northwestern University Mr. Mehren spoke on "Some Elements in Engineering Success."

Ashtabula Retains Present Charter

By a vote of 2,775 to 2,336, the voters of Astabula, Ohio, decided to retain present commission-manager and proportional representation charter.

Rivers and Harbors Convention

The National Rivers and Harbors Congress will hold its sixteenth annual meeting at the New Willard Hotel, Washington, D. C., Dec. 8 to 10. The announcement states that the speakers will include men who are using or have tried to use water transportation and who will tell of difficulties met and results secured. John H. Small is president, and S. A. Thompson, 824 Colorado Building, Washington, D. C., secretary.

Southern Pacific Company Orders Manganese Steel Rail

The purchase of 2,000 tons of manganese steel rail, at a cost of $375,000, was approved by the Executive Committee of the Southern Pacific Co., Nov. 11. This rail is to be used on curves of from 6 to 12 deg. between Kern Junction and Tehachapi, Cal., a distance of 47 mi., and between Truckee and Blue Canyon, Nev., a distance of 41 mi. It is understood that the decision to use manganese rail for curves on these divisions is primarily a safety measure and is based on the experience of the Delaware, Lackawanna & Western R.R. The Southern Pacific Co. will use the manganese rail both for outer and inner rail.

The rail will be produced by the electric furnaces of the Illinois Steel Co., and ordered through Manganese Steel Rail Co. The manganese content is 10.5-15.0 per cent, carbon running 0.92 to 1.10 per cent. The rail is quenched in water immediately after passing the hotsaws. The rail webs at the ends are drilled with high-speed drills and copper plugs are pressed and sweated in to provide for rail bonding since track drills are not capable of drilling the steel.

Utility Commissioners Meet in Washington

Sentiment Against Government Ownership and Centralized Regulation—Valuation Report

Limitation of the authority of state railway and public utility commissioners by current interpretations of the Transportation Act was the principal topic under discussion at the meeting in Washington last week of the National Association of Railway and Utility Commissioners, at which the state commissioners expressed strong sentiment against government ownership as well as "over-centralized" regulation by the Interstate Commerce Commission. An out-and-out declaration against government ownership of railroads by T. J. Lucey, of the Illinois commission, was received with bursts of applause. In 1914, sentiment among some commissioners inclined toward government ownership. The efforts of the railroads to escape state regulation very evidently had put each state commissioner on his mettle. The determination to fight against the loss of rate-making powers, or any other limitation of the authority of the state commissions was at all times evident.

Valuation Report

The valuation committee took a stand against the cost of reproduction method on the ground that it "now leads to unwarranted and unreasonable values which offer little guidance in determining the fair value of the property of public utilities, and the continuance of the cost of reproduction theory as the controlling factor in public utility valuation will in the future undoubtedly cast a burden upon those utilities which were required by public necessity to make substantial plant investments during the high price period." It was not intended, however, that "fair value rule should be abandoned or impaired but rather that under the fair value rule and in view of abnormal conditions prevailing, a greater measure of justice and equity will be secured by giving greater weight to the honest and prudent investment and less weight to the cost of reproduction or cost of reproduction less depreciation."

The matter of car distribution was one of the principal topics of the meeting. It was precipitated by an address by Commissioner Clyde B. Aitchison, of the Interstate Commerce Commission. Issue was taken with the Interstate Commerce Commission's policy, both in the handling of grain and of coal cars. At the invitation of the Association of Railway and Utility Commissioners, representatives of the public utilities were in attendance. M. H. Aylesworth, of the National Electric Light Association, and George W. Elliott, of the National Committee on Gas and Electric Service, told how the utilities throughout the country have been kept in a state of continual uneasiness, due to the piece-meal fashion of coal deliveries. Only good luck and the extended period of good weather have avoided numerous suspensions of service, they declared. Mr. Aitchison said the Commission had withdrawn assigned cars for public utility coal because the utilities abused the privilege. Since there were not enough cars to go around, he said there was no avoiding the use of priorities.

Officers elected for the ensuing year are: James A. Perry, of the Georgia Commission, president; Carl D. Jackson of the Wisconsin Commission, first vice-president; Dwight N. Lewis, of the Iowa Commission, second vice-president. James B. Walker, of the first district New York Commission, was re-elected secretary of the Association.

President Perry appointed the following executive committee: Carl D. Jackson, Wisconsin, chairman; Joseph B. Eastman, Interstate Commerce Commission; E. I. Lewis, Indiana; Clyde M. Reed, Kansas; R. H. Burr, Florida; A. M. Barrett, New York; J. J. Murphy, South Dakota.

The following were named on the committee on litigation: Fred W. Putnam, Minnesota, chairman; Dwight N. Lewis, Iowa; W. D. B. Ainey, Pennsylvania; Allison B. Mayfield, Texas; J. A. Kellogg, New York; William G. Busby, Missouri; R. H. Burr, Florida.

Manitoba Engineers To Enforce Salary Schedule

A pledge not to accept a salary lower than a specified schedule is being asked of members of the Manitoba branch of the Engineering Institute of Canada. Minimum salaries from $3,600 to $10,500 per year are listed in the schedule prepared by the remuneration committee for different branches of professional service; a maximum is suggested also, except for the highest positions. It has been decided that any engineer who fails to receive the salary recommended for his class of service will be assisted to obtain other employment at adequate remuneration and will receive moral and financial support. Records are to be kept of all engineers in the employ of large corporations and industries, with their positions and salaries. Where the salary is below the schedule, the employer will be requested to appoint a representative to discuss the matter with the committee, with a view to adopting the schedule rate.

Federal Aid Sought for Ohio River Bridge Project

Representatives of the Chamber of Commerce of Evansville, Ind., have planned a trip to Washington in an effort to obtain federal aid in building a bridge across the Ohio River. The State Highway Commissions of Indiana and Kentucky will be asked to lend assistance to the project and the next step will be to have the legislatures of the two states lend financial aid to the enterprise. Business interests in Evansville have for a number of years urged a bridge across the river at this place.

Wanaque Dam Contract Let To Walter H. Gahagan

Walter H. Gahagan, Inc., of Brooklyn, was the successful bidder on the construction of a portion of the Wanaque dam, let Nov. 9 by the North Jersey District Water Supply Commission. The contract was let on a cost-plus-a-percentage basis, the contractor to share in any reduction in unit costs up to a certain per cent, or to bear a share of added expense through an increase in cost of materials and wages named in the contract, as explained in *Engineering News-Record*, Nov. 4, p. 878. However, no matter what the expense of the work may be, the contractor is assured of a 4 per cent fee.

As against the cost-plus bid, the Rollin Construction Corp., of New York City, tendered a bid on a straight unit price basis, agreeing to do the work for $1,421,227, which was the low bid, being under the engineer's estimate and the bid of the Gahagan company by $7,889. The Rollin Corporation being the lowest bidder, believed itself entitled to the contract. As the members of the commission apparently think that the cost-plus contract will prove the less expensive method of doing the work because of some indication of a fall in material prices and a possible decrease in the price of labor named in the contract, that bid was made the successful one.

Officers of the Rollin organization see in the award of the contract to the Gahagan Co. a contest between the cost-plus and unit price methods of bidding. They point out that though there may be a saving through a reduction of material prices and wages, there is greater possibility that the ultimate cost will exceed the bid price and that that situation could have been avoided through the acceptance of theirs, the lowest bid. Some of the reasons why they believe that a cost-plus contract would not be the better in this case are given herewith:

1. A decided increase in overhead due to enlarged auditing, checking and inspecting forces employed by the contractor and similar expense on the part of the owner.

2. The inability of the contractor to secure the best results from his labor because of the impossibility of offering either a bonus or increased pay without subjecting himself to the criticism of the engineer that he is paying more than the prevailing rates.

3. The feeling of the contractor that he lacks freedom to employ special construction methods which would subject him to severe criticism of the engineer, if they failed, but would result in great saving, if they were successful.

4. The natural inhibition set up against the purchasing forces trying to secure the best in material prices.

Bids were called for on two classes of construction: Class 1 and Class 2, the former containing 26 items of actual construction and Class 2 including overhead, freight charges, miscellaneous materials, supplies, buildings, etc. The engineer's estimate on the first class of construction was $1,124,150 and on Class 2, $250,000. Added to these prices is the 4 per cent fee, which total made up the successful bid.

National Research Council

(Continued from p. 1010)

research men, the best obtainable, so that results may be obtained as quickly as possible. One of the outstanding features of the conference was the feeling that a certain per cent of all moneys now available for highway construction could be saved were more research work done, and that the work must be done quickly and the results widely spread.

Though few of the organizations present had formal instructions from their individual bodies as to what specific action they should take in the organization of the advisory board, Col. F. A. Molitor and Samuel Whinery, representing the American Institute of Consulting Engineers, had been instructed to carry to the conference the information that the board of direction of the consulting engineers had passed a resolution calling for the setting aside by Congress of a certain sum from the unexpended balance of Federal-aid money with which to employ trained and experienced men in the field of highway research. The resolution will be acted upon by the consulting engineers regardless of what action the advisory board takes in the matter, and they will carry their fight to secure such an appropriation through the Chamber of Commerce of the United States, and its constituent membership. However, the conference agreed that the course of action taken by the consulting engineers would be, in effect, its action.

Plan of Organization

Membership in the Advisory Board of Highway Research is to be open to "those organizations of national importance interested in design, construction, maintenance, economics and financing of highways, in materials and equipment therefor and in vehicles used on highways; governmental departments and bureaus of similar interests, and higher educational institutions, each acting through one duly appointed representative with authorization to name an alternate, serving until his successor is appointed."

It is the plan to employ a highly paid director under whom the corps of research men will operate, and who will manage the affairs of the board. Such a director is to be a professional engineer of experience and ability. The board is also to have a chairman and a vice-chairman and these two, acting ex-officio with three members of the Division of Engineering of the National Research Council, are to form the executive committee. Anson Marston, Dean of Engineering, Iowa State College, was named the chairman of the permanent board to serve for one year, and the interim director is A. D. Flinn. The annual meeting is to be the second Thursday in November, at such a place as the chairman may designate.

Inasmuch as the Advisory Board has been given the moral support informally of the organizations attending the conference, it will lack a permanent, definite character until representatives of all technical bodies present have reported back to their various societies and have secured definite expressions as to what final action these societies will take. This procedure, it is hoped, will be early accomplished and the organization immediately begin its important functions.

During the conference three committee reports of the Division of Engineering of the National Research Council were heard, as well as several short discussions as to the need for research in highway matters. Thomas H. MacDonald, Chief of the Bureau of Public Roads, pointed to the fact that but 1 per cent of the Federal budget for the fiscal year ending June 30, 1920, had been expended upon research and of that amount 63 per cent had gone to the Department of Agriculture. Of the total budget 3 per cent represented money available for public works and of that amount 59 per cent was to be spent for highway construction. With a program calling for the expenditure of more than $1,000,000,000 on highways now under way, he stressed the necessity of making as clear as possible the fundamental problems upon which the economic expenditure of this money rested.

Both Prof. C. A. Adams, and Prof. Anson Marston emphasized the need for co-operation in research matters.

Proposed Work Outlined

Some of the work that was to be taken up was outlined in the reports of two committees of the engineering division. Prof. T. R. Agg, of Iowa State College, and chairman of the committee on the economic theory of highway improvement, reported that the Kansas Agricultural College was making experiments upon wind pressures on motor vehicles; that the Motor Transport Corps of the United States Army was doing important research work and that a report from its chief, Colonel Ireland, was forthcoming; and that other organizations were investigating the effects of grade and curvature on gasoline consumption. A. T. Goldbeck, engineer of tests, U. S. Bureau of Public Roads, and chairman of the committee on structural design of roads, explained what tests were now being made to determine the relative bearing power of various subgrade materials and what was being done to strengthen the bearing power of soils either through mechanical or chemical means. He also explained that through impact tests results carried on, road slabs of many designs and upon varying subgrades had been broken down with the exception of a 10-in. slab under certain tests. He said it was the intention of the Bureau of Public Roads to build next year, test sections under conditions that will accelerate the tests made and that impact results already secured will govern the design, to a certain extent, of such test sections.

The morning session of the conference was given to a temporary organization, the discussion of the general situation and the appointment of committees. At the afternoon session committee reports were heard, the following committees having been named at the morning session, when Dean Marston was elected temporary chairman, and C. D. Curtis, of the Bureau of Public Roads, secretary: On organization and by-laws; membership and officers of general advisory board; and research committees.

A roster of these present is given herewith:

Representative	Organization
Prof. C. A. Adams	
Prof. T. R. Agg	State Highway Department at Iowa.
	American Association of State Highway Officials.
	Engineering Division Committee on Economic Theory of Highway Improvement.
A. Blanchard	A. S. T. M.
	Highway Engineering Department, University of Michigan.
C. J. Bennett	American Association of State Highway Officials.
	State Highway Commission of Connecticut.
David Beecroft	S. A. E., Chairman of their Meetings Committee.
H. W. Crane	S. A. E., Chairman of their Research Committee.
Robert A. Cummings	A. S. C. E.
C. D. Curtis	Bureau of Public Roads.
A. D. Flinn	Secretary, Engineering Council.
A. T. Boldbeck	Engineering Division Committee on Structural Design of Roads.
	Bureau of Public Roads.
M. C. Horine	S. A. E., member of their Committee on Science of Truck Operation.
P. Hubbard	A. S. T. M.
Prof. H. J. Hughes	Harvard University.
Pyke Johnson	National Automobile Chamber of Commerce.
A. N. Johnson	A. S. T. M.
	University of Maryland.
R. D. Chapin	President of Hudson Motor Car Co.
J. F. Langthorn	A. S. C. E. Director.
Anson Marston	Dean of Engineering, Iowa State College.
T. H. MacDonald	Bureau of Public Roads
E. B. Mathew	Association of State Geologists.
F. A. Molitor	American Institute of Consulting Engineers.
D. E. Moran	A. S. M. E.
H. DeB. Parsons	A. S. M. E.
J. W. Patterson	Rhode Island State Board of Public Roads.
N. B. Pope	S. A. E.
H. H. Porter	A. S. C. E., Member Engineering Division.
C. S. Reeve	A. S. T. M. representing their Committee D-4 on Engineering Division.
	Division Committee on Character and Use of Road Materials
A. N. Talbot	Western Society of Engineers.
	University of Illinois.
G. S. Webster	Department of Public Works, Philadelphia, A. S. C. E. Member of Division.
S. Whinery	American Institute of Consulting Engineers.
	American Automobile Association.
F. R. McMillin	American Concrete Institute.
M. O. Eldridge	A. A. A., Good Roads Committee.

Manufacturers Plan Big Exhibit at Road Builders' Convention

Representatives of fifteen industries identified with highway construction held a meeting at the Automobile Club of America, New York City, Oct. 22, to complete the organization of an advisory committee of manufacturers to co-operate with the American Road Builders' Association in holding a great exposition of highway equipment and materials at the association's annual convention which will be held at the Coliseum, Chicago, during the week of Feb. 7, 1921.

The industries represented at the forthcoming exposition will include the sand and gravel industry; crushed stone; portland cement; asphalt and and oil; tar; granite block; paving brick; slag; road building machinery; quarrying machinery; excavating machinery; trucks, tractors and trailers; concrete mixers; engineering instruments and explosives. It was developed at the meeting that upward of $1,000,000,000 is annually available for highway and street work and that a genuine necessity exists for capacity production and distribution of highway materials and equipment.

An executive committee to represent the producers and manufacturers was appointed consisting of J. E. Pennybacker, Secretary, Asphalt Association; B. H. Wait, District Engineer, Portland Cement Association, New York City; W. T. Chollar, Lakewood Engineering Co.; D. C. Fenner, International Motor Truck Co.; and P. P. Sharpless, Barrett Co. A Chicago committee was also appointed with S. F. Beatty of the Austin-Western Road Machinery Co. as chairman.

Construction Interests To Hold First Congress Next Year

As the result of a recent meeting of the organization committee for the formation of a congress of the building and construction industry, a decision was reached to convene the first national congress of building and construction in Chicago, Feb. 1, 1921. This congress will consist of 160 members made up of twenty representatives of the following eight interests which go to form the construction industry: Labor, finance, general contracting, subcontracting, engineering, architecture, manufacturers of equipment and material, and dealers in equipment and material. The recent meeting of the organization committee was its third one and was held in Pittsburgh, Oct. 29.

Forty members of the congress will act as an executive committee, each of the eight elements previously named having five members on it. The following ten men have been selected so far to serve in the first national congress: Robert D. Kohn, Sullivan W. Jones, W. G. Luce, Walter Stabler, and L. K. Comstock, New York City; Morris Knowles, Pittsburgh; John Donlin, Washington; Col. J. R. Wiggins, Philadelphia; Thomas R. Preece, Indianapolis; and Wharton Clay, Chicago.

The preliminary organization committee consists of the following men: Robert D. Kohn, New York City; M. B. Medary, Jr., Philadelphia; E. J. Russell, St. Louis; General R. C. Marshall, Jr., Washington; Colonel John R. Wiggins, Philadelphia; W. A. Rogers, Chicago; L. K. Comstock, New York City; Oscar A. Reum, Chicago; F. W. Howard, Boston; Wharton Clay and W. L. Hodgkin, Chicago; Morris Knowles, Pittsburgh; F. C. Shenehon, Minneapolis; Thomas R. Preece, Indianapolis; John Donlin, Washington, D. C.; J. Willison Smith, Philadelphia; and Walter Stabler, New York City.

The permanent headquarters of the executive committee has already been established at 19 W. 44th St., New York City.

Belle Isle Bridge Bids Rejected

Bids for the proposed Belle Isle bridge at Detroit were opened by the Department of Public Works on Oct. 29, but no contractor bid on the complete job. Ten contractors bid on one or more of three (out of four) groups work required in the erection of the bridge No bid was received on group C, which includes excavation, piling, reinforced concrete, concreting after the placing of the steel, sewers, paving base, electrical work, and miscellaneous. If the lowest bids for the construction of the other three groups were accepted the cost of the bridge would run considerably over the $3,000,000 originally appropriated for its construction. Of these three groups, A includes removal of old bridge piers, excavation, footings, docks, cofferdams; B includes 3,300 tons of structural steel and 10 tons of bronze bearings; D includes metal hand railing and lamp frames.

After first recommending that the $1,951,850 bid of Geo. R. Cooke, a local contractor on A, be accepted, and all other bids rejected, the commissioner of Public Works later recommended that all bids be rejected. This recommendation was made after the Corporation Counsel expressed the opinion that it would be a breach of faith to the public to contract for any portion of the construction when the amount approved by the people is sure to be exceeded. It is claimed that the bridge will cost nearly double the amount authorized. The council therefore rejected all bids, although the bid for Group A was considered satisfactory. Later, however, it reconsidered this action and decided to hold a hearing.

The total of the low bids on the three out of four groups of construction advertised is $2,682,000. This would make the total cost of the bridge more than $5,000,000.

H. H. Esselstyn, of Esselstyn, Murphy & Hanford, engineers for design and construction of the bridge, maintained that the council itself accepted a bid tending to place the total cost above $3,000,000, when it awarded a contract for the construction of the subway approach at a cost of $360,000. The estimated cost of the approach made by the engineers in 1917 was $192,000 and it was on this estimate along with the others that the $3,000,000 bond issue was placed on the ballot.

Canadian Society Officers Named

The nominating committee of the Engineering Institute of Canada has selected the following candidates for office for the year 1921: President, J. M. R. Fairbairn, Montreal; vice-presidents, Walter J. Francis, Montreal; Arthur Surveyer, Montreal; A. A. Dion, Ottawa, and E. G. Matheson, Vancouver.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, New York; Washington, D. C., Nov. 18-19.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Washington, D. C., Dec. 13-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19, 1921.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

The Oklahoma Highway Engineers' Association, at a recent meeting, elected the following officers: Will M. Clarke, president; Pearl Little, vice-president; Floyd Frazier, second vice-president; Frank Herrman, secretary-treasurer.

The Texas Section, Am. Soc. C. E., held its fall meeting at Austin, Oct. 20 and 21. The following officers were elected: President, J. H. Brillhart, Dallas; 1st vice president, F. E. Giesecke, Austin; 2nd vice president, J. C. McVea, Houston; secretary-treasurer, E. N. Noyes, Dallas. A number of technical papers were presented. General R. C. Marshall, general manager, Associated General Contractors of America, discussed the relation between the engineer and contractor. A standing committee was appointed to work out details on a standard form of contract with arbitration clause and submit the same to the members by letter-ballot for approval. A committee on redistricting of the American Society of Civil Engineers reported in favor of the present District No. 11 and against any change. Committees were appointed to work on an Engineers License Law and present the same to the Legislature, and to bring in a resolution on the water power bill now before Congress. A copy of this resolution as approved by the meeting is enclosed.

The Boston Society of Civil Engineers, Sanitary Engineering Section,

was addressed by T. Chalkley Hatton, chief engineer Milwaukee Sewerage Commission, on Nov. 10. Mr. Hatton described the activated-sludge tests and the plans for the activated-sludge plant at Milwaukee. The plans have now reached the final stage. (See *Engineering News-Record*, May 20, 1920, p. 990, for article on this subject by Mr. Hatton.)

PERSONAL NOTES

J. A. HEAMAN, formerly resident engineer, Western Lines, Canadian National Railways and Grand Trunk Pacific Ry., Winnipeg, Canada, has been appointed assistant chief engineer.

JOSEPH GASTON LEGRAND, who has been with the Grand Trunk Pacific Ry. since 1906, has been appointed bridge engineer, Western Lines, Canadian National Railways and Grand Trunk Pacific Ry., Winnipeg, Canada.

D. L. REABURN, who was superintendent of Mount Rainier National Park from June, 1915, to April, 1919, and later with the Western Willite Road Construction Co., Los Angeles, has been appointed superintendent of the Grand Canyon National Park. He has served as locating engineer on the Alaskan Railway and the Argentine Government Railways and as division engineer on the construction of the Los Angeles Aqueduct.

CARL NYMAN, formerly resident engineer, State Road Commission, Utah, has resigned to enter private practice in general engineering in the coal fields of Carbon County, Utah, with headquarters at Castlegate.

V. H. CLEMENTS has taken a position as assistant engineer in the office of the Irrigation Engineer, Bureau of Public Roads and Rural Engineering, U. S. Department of Agriculture, San Antonio, Tex.

FRANK MUTH, Manitowoc, Wis., has resigned as highway commissioner of Manitowoc County to engage in highway and bridge contracting.

A. H. MARKWART has been appointed director of engineering with the Pacific Gas & Electric Co., San Francisco, and will have supervision over the organization's hydraulic, production, transmission and distribution engineers. He will also be in charge of designs on all company plants and equipment. He is a member of the firm of Galloway & Markwart, consulting engineers, San Francisco, and during the Panama-Pacific Exposition he was assistant director of works.

W. G. VINCENT, JR., formerly valuation engineer, Pacific Gas & Electric Co., has been appointed executive engineer in charge of rate schedules and collection of data on company property. He will undertake an intensive study of economic features affecting the development of the company for the guidance of the engineering, construction and operating departments.

HARRY C. WILLIAMS has resigned as chief construction engineer, Louisville & Nashville R.R. to become president and general manager of the Campbell Coal Companies, Knoxville, Tenn.

JOHN J. HAASLER, formerly office engineer, Nueces County Highway Department, Tex., has accepted a position as field engineer with the Power Department of San Antonio, Tex.

W. H. CORDDRY of the Harrisburg office of Gannett, Seelye & Fleming, Inc., engineers, has been placed in charge of the Memphis office of that company.

J. G. JOHNSON, formerly with the Milwaukee Gas Light Co. and engineer-inspector of the Milwaukee Sewerage Commission, has been engaged as city engineer and superintendent of waterworks, Milwaukee, Wis.

J. T. GILLESPIE has resigned as engineer in charge of equipment, Milwaukee Highway Commission, to accept a position as assistant to the president of the Marquette Cement Manufacturing Co., Chicago.

U. STEPHENS, formerly resident bridge engineer, Runnels County, Tex., has been appointed county engineer of the same county.

H. C. WEBSTER, for several years estimating engineer for Schmidt Brothers Construction Co., Chicago, has accepted a position as estimating engineer for H. Schmitt & Son, Milwaukee.

HENRY H. WILSON, Hughesville, Pa., for the past eight years connected with Winston & Co. of New York City and Richmond, Va., has been elected president of the Associated Pennsylvania Highway Contractors.

MAJOR LEON L. CLARKE, formerly electrical and mechanical engineer for the Chicago Subway Commission and Captain E. A. Clark, civil engineer, have organized the Subway Engineering Co. with office in Chicago. The company will engage in engineering and contracting in subway, tunnel, bridge and foundation construction.

WILLIAM M. ROSEWATER, formerly commercial engineer with the Bucyrus Co., South Milwaukee, Wis., and for 21 years connected with that organization, is now consulting mechanical engineer for the Pacific Metals Corporation, New York, engaged in designing and building a placer dredge for work on the properties of this company in Colombia, South America.

E. M. ARNOLD, formerly county engineer, Boone County, Ky., has accepted a position as assistant division engineer in the Second District, State Highway Department of Georgia.

H. L. KYLE, formerly roadmaster at Sacramento, has been appointed engineer of the Western Division, Western Pacific.

EMERY WELLS, formerly with the Turner Construction Co., New York, is now with Berkebile Brothers, engineers, Johnstown, Pa., as specialist on reinforced concrete construction.

J. S. GOODMAN, formerly division engineer of the Philadelphia & Reading Ry., at Tamaqua, Pa., has been appointed division engineer with headquarters at Reading, Pa.

N. W. H. SCHAFER, division engineer, Philadelphia & Reading Ry. at Harrisburg, Pa., has been transferred to Tamaqua, Pa., as division engineer to succeed J. S. Goodman.

OBITUARY

JOHN R. ALLEN, heating and ventilating specialist, died at Pittsburgh, Pa., Oct. 20. He was born in Milwaukee, 1869, and was graduated from the University of Michigan, engineering department, in 1892. He was connected with the college of engineering, University of Michigan, for about 21 years. In 1917 he resigned to become dean of the college of engineering and architecture, University of Minnesota. Later he was appointed director of the research laboratories, American Society of Heating and Ventilating Engineers, at Pittsburgh. At the time of his death he was acting as consulting engineer on ventilation to the chief engineer of the New York and New Jersey commissions in charge of the construction of the Hudson River vehicular tunnels.

ARTHUR M. WAITT, consulting engineer and railroad specialist, died Nov. 10 at Sharon, Conn. He was born in Boston in 1858 and was graduated from the Massachusetts Institute of Technology in 1879. Mr. Waitt had been engaged in railroad work for about 40 years: 1879-1884 he was connected with the Chicago, Burlington & Quincy R.R. as draftsman; 1881-1884, Eastern R.R. (Mass.) as draftsman, chief draftsman and foreman car department; 1888, assistant manager, Pullman Car Company's works at Pullman, Ill. In 1889 he entered the service of the Lake Shore & Michigan Southern Ry. as assistant general master car builder and later became general master car builder. In 1899 he was made superintendent of motive power and rolling stock, New York Central & Hudson River R.R. Co. From Sept. 1903, to March, 1904, he made a study of heavy electric traction in Europe and the United States. At the time of his death and since 1905 he was engaged in private practice as consulting engineer and railway specialist. Mr. Waitt had reviewed a number of books on locomotives for *Engineering News-Record*.